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AUTOMOTIVE ENGINEERING LABORATORY

REPORT ON

ENVIRONMENTAL TEST OF PERSHING

COMMUNICATIONS PACK NO. 1

Report No. DPS-244

(OMS Code No. 5210.12.127X2.03.39)

SUBMITTED:

Ray L. Wiles
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61-3-4
NOX

APPROVED:

R. P. Witt
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FOR THE DIRECTOR

JUNE 1961

Aberdeen Proving Ground
Maryland

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AUTHORITY: OMS Code No. 5210.12.127X2.03.39 RLWiles/tsp/49201
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ENVIRONMENTAL TEST OF PERSHING COMMUNICATIONS PACK NO. 1

Report No. DPS-244

Dates of Test: 1 June 1960 to 30 March 1961

ABSTRACT

The communications pack was subjected to a wide range of environmental conditions including climatic phases of rain, wind, high and low temperatures, humidity and icing; table vibration consisting of a low-input resonance search in the three major axes; and a road-shock and vibration test at various road speeds over the 6-inch washboard, level paved and ramp courses. While several problem areas were noted, the communications system would still transmit and receive at the conclusion of the test. It was recommended that action be taken to correct the shortcomings encountered and that an improved version be subjected to further testing.

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(The Annex is on file in the Technical Library, APG, for reference purposes. It may be consulted there.)

1. INTRODUCTION

The PERSHING communications pack No. 1 (AN/TRC-80 communication terminal) was submitted to Aberdeen Proving Ground for environmental and road testing. The primary responsibilities of Aberdeen Proving Ground in this program were to provide the facilities for inducing the desired environments and the instrumentation for accurately describing them, and to supply shop facilities and personnel support necessary to carry out the program.

The functional check-out and maintenance of the equipment was the responsibility of the manufacturer or agency supplying the specific components.

2. DESCRIPTION OF MATERIEL

The communications pack is a self-contained component of the PERSHING missile system ground-support equipment. It is designed for duplex transmission of one voice and one teletype circuit. It consists of the communications system, engine-generator set and air-conditioning system, all housed in an insulated hut approximately 100 by 80 by 66 inches in dimension. The total weight was 4100 pounds. Figures 1 through 4 show general views of the pack during various stages of testing.

3. DETAILS OF TEST

3.1 Procedure

The basic procedure followed during this program was established by a technical committee made up of representatives of the interested agencies which were responsible for the test and evaluation of the communications pack. A copy of this procedure is contained in the annex of this report. The following paragraphs list the tests in the sequence in which they were conducted, and give a brief resume of each.

3.1.1 Climatic Phase. The climatic phase included subjecting the pack to high- and low-temperature, humidity, icing, and rain tests. Inspection and functional check-outs were made before, during and after these phases. For phases other than the rain test, the general range of environments covered were:

a. Operation at +125°F.

b. Storage at +160°F.

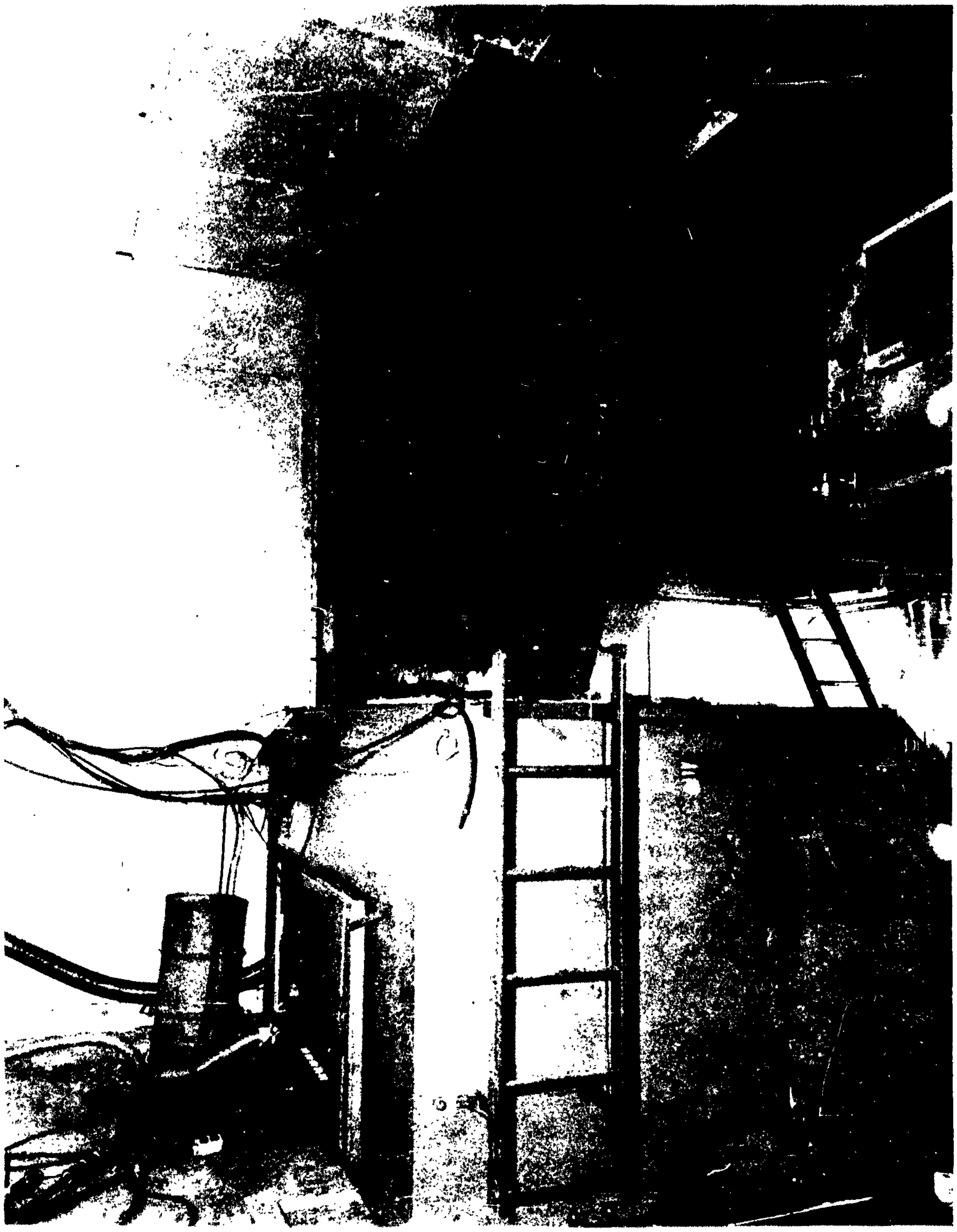

Figure 1: Communications Pack with Antenna Raised, in Climatic Chamber.

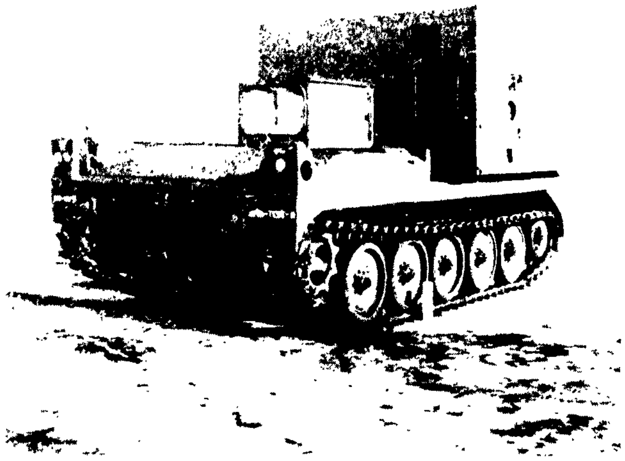

Figure 2: Three-Quarter View of Communications Pack Mounted on the XM474 Vehicle.

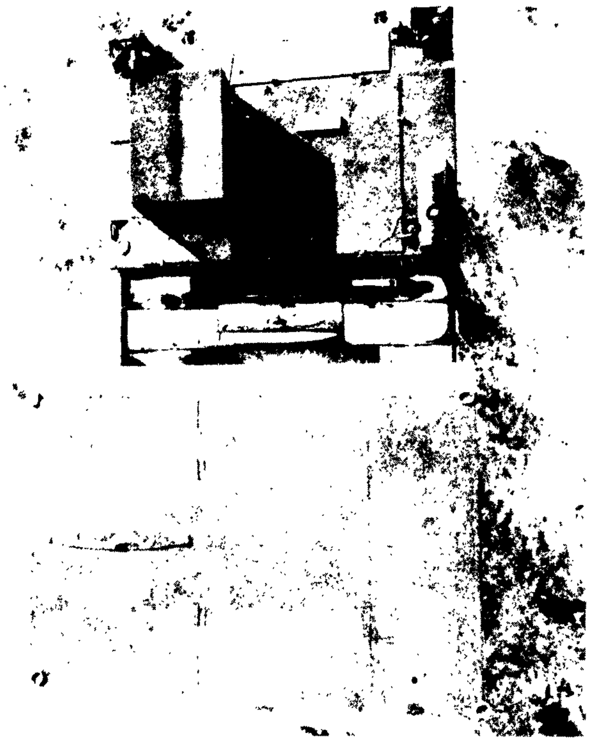

Figure 3: Top View of Communications Pack Mounted on XM474 Vehicle.

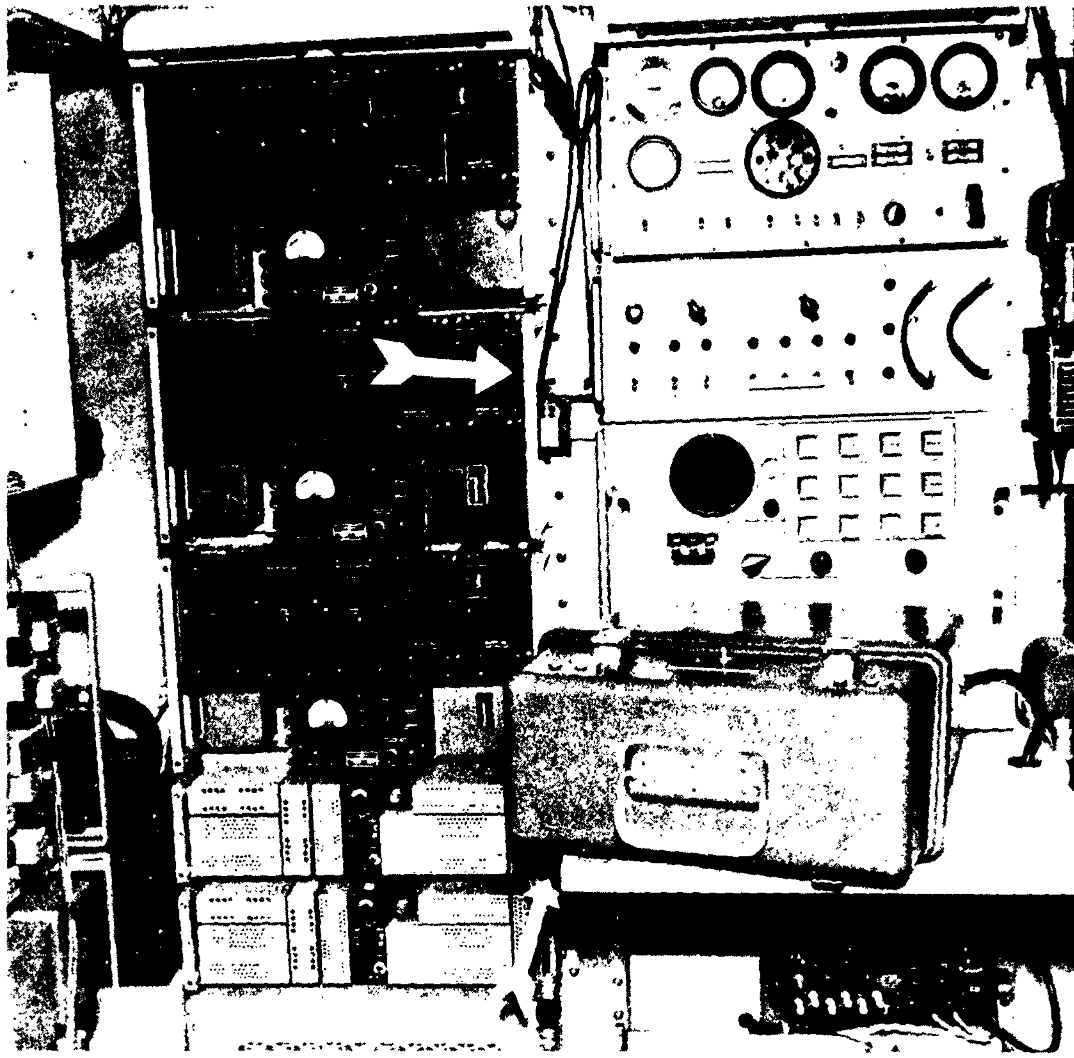

Figure 4: General Inside View, Forward Area of Communications System Compartment.

c. Operation at +25°F and -65°F.

d. Operation after storage at +80°F and 90 to 95% relative humidity.

The rain test was conducted with and without accompanying wind to check for leakage through the hut and to determine if the antenna could be raised and lowered in rain accompanied by 35-to 45-mph winds. Fireman-type fog-spray nozzles were used for the rain test and a B-29 bomber engine and propeller created the desired wind velocity.

3.1.2 <u>Table Vibration.</u> This test was limited to a low-input resonant search in the three major axes. The pack proper was subjected to inputs up to 0.75 g over a frequency range of 5 to 500 cps. Forty channels of information were recorded.

3.1.3 <u>Road Testing.</u> Road testing was limited by request to road-shock and vibration measurements. Gross weight of the vehicle with pack was 16,890 pounds for this test. Eighteen channels of information were recorded. The test courses and road speeds to which the pack was subjected are as follows:

a. Six-inch washboard at 7, 9 and 15 mph.

b. Bituminous concrete (paved) at 8 to 36 mph in 2-mph increments.

c. Ramp course at 5 to 11 mph in 1-mph increments.

d. Braking (on paved) at 5, 10, 15 and 20 mph.

3.1.4 <u>Special Tests.</u> The Human Engineering Laboratory conducted the following tests:

a. Sound-pressure level.

b. Exhaust-gas analysis.

c. Word intelligibility.

d. Air velocity at operator's head.

e. Radiated-power density level and other health hazards in conjunction with the U. S. Army Environmental Health Laboratory. (Results of these tests will be reported separately by the agencies conducting the studies.)

3.1.5 Operational and Visual Check-Out. Personnel from the agencies responsible for the major components made visual and functional check-outs of their equipment as applicable throughout the test program.

3.2 Results

3.2.1 Climatic Phase. During the rain test the pack was orientated so that the edge of the antenna bag and the long axis of the hut was normal to the wind. Approximately 18 minutes were required for two experienced men to lower and stow the bag, compared with 10 minutes to raise it. Difficulty was experienced in controlling the deflated bag and securing the locking stubs. It was quite evident that improvements could be made which would reduce the time and effort required for this. The water supply was exhausted before the lowering process was completed; however, this did not appear to increase the ability of the personnel to control the bag in the wind. At this point in the testing, it was discovered that the antenna base had loosened, and this permitted considerable fore and aft whipping of the inflated bag. Due to this, raising and lowering the antenna at other orientations to the wind was not attempted. Severe leakage of the hut occurred with and without the accompanying wind.

Several problems were encountered during the temperature, humidity and icing tests. Most of these were associated directly or indirectly with the air-conditioning system and engine-generator set. Sagging of the hut roof at plus 100°F and warping of the personnel door and buckling of the floor occurred at minus 25°F. These events were attributed to hut construction. Figures 5 and 6 show ice deposits during the icing test. Complete details of this phase are contained in Automotive Engineering Laboratory Report No. 60-54, Appendix B.

3.2.2 Table Vibration. Table vibration was limited by request to a low-input resonance search in the three major axes. No significant damage was sustained by the pack during this test, although some amplifications of the inputs and minor resonances were noted. Figure 7 shows test setup for the resonance search in the vertical plane and Figure 8 shows it for the horizontal plane. Complete details are contained in Physical Test Laboratory Report No. 61-T-2 in Appendix B.

3.2.3 Road Shock and Vibration. Several discrepancies were noted during this test; however, the communications system would transmit and receive at the completion of the test operation. While many of the problems were considered minor, in that they can be easily corrected, certain of them such as those that occurred in the antenna compartment, will require design consideration. See Figure 9.

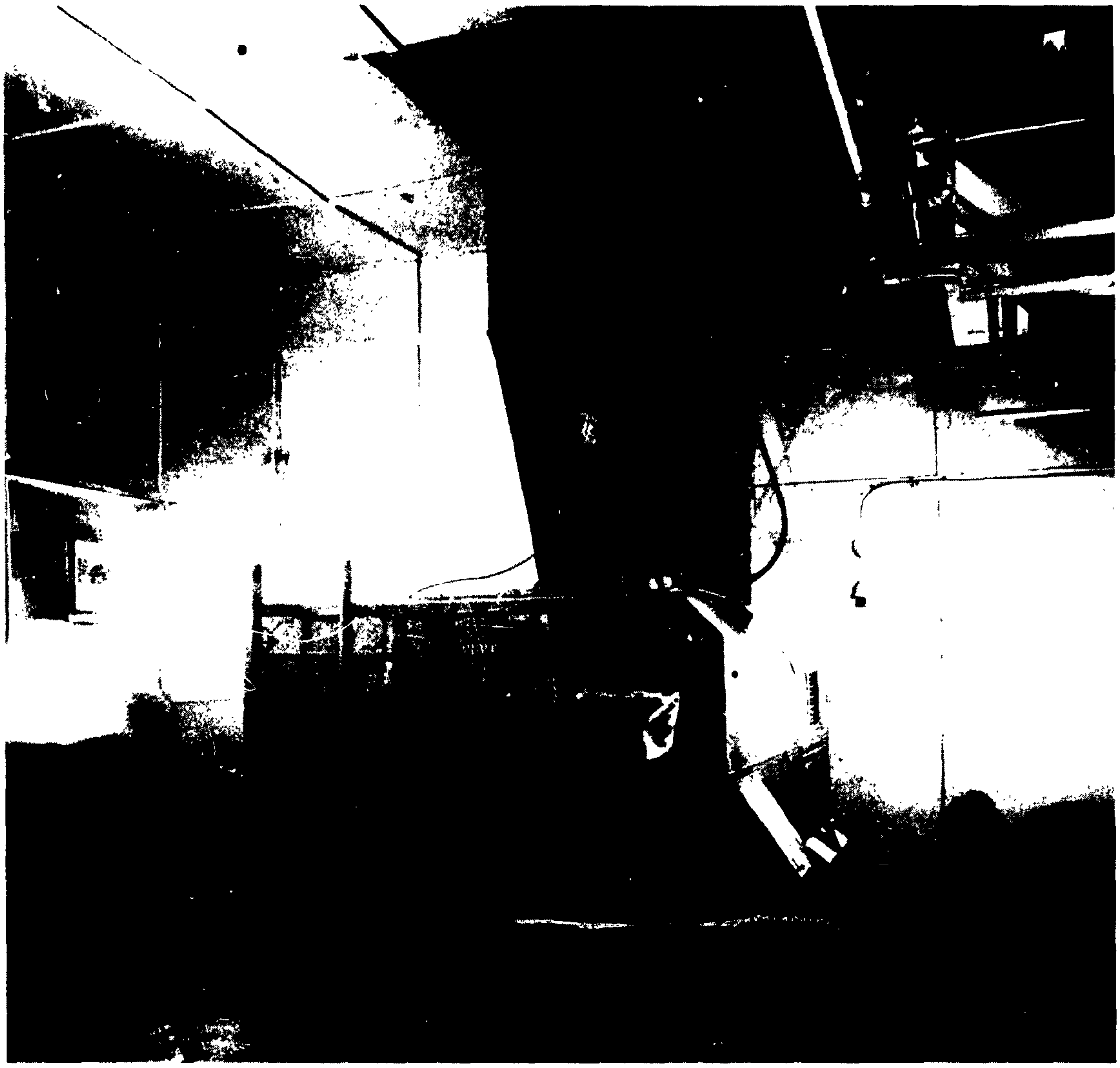

Figure 5: Accumulation of Ice on Antenna during Icing Test.

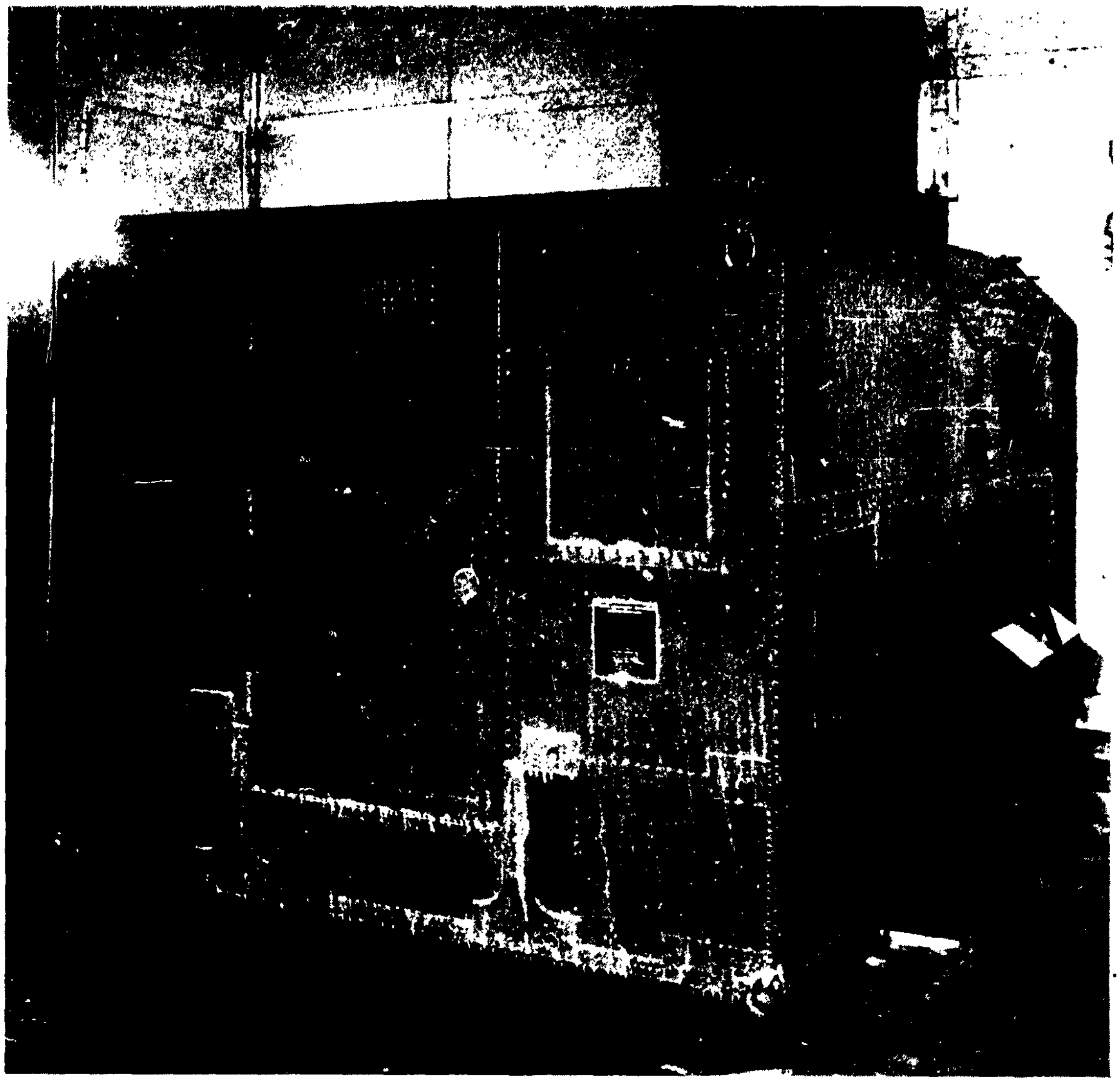

Figure 6: Accumulation of Ice on the Shelter during Icing Test.

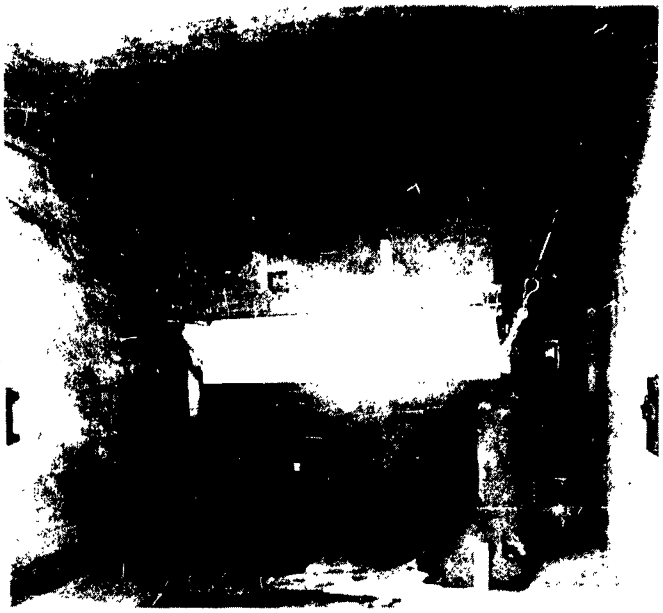

Figure 7: Communications Pack Mounted on Shaker for Resonance Search in the Vertical Plane.

Figure 8: Horizontal Vibration Test Setup. Front End View.

Figure 9: View through Door, Showing Damaged Cable Pulleys in Antenna Storage Area.

Shock inputs up to 16 g were recorded on the ramp course at certain locations and may have contributed materially to the damage in the antenna compartment. Vibration set up from operation on a level, hard surface appeared to present the most severe environment with respect to the electronics and their mounting arrangement. This is primarily due to the fact that the natural frequency of the components is at or near the frequencies of the vehicle track and suspension.

Complete details of this phase, including acceleration levels, frequency ranges, problem areas and operational conditions, are contained in AEL Report No. 61-16, Appendix B.

No endurance mileage was accumulated on this pack due to the many modifications contemplated and since a modified unit will be subjected to extensive test operation at Aberdeen Proving Ground in conjunction with other components of the PERSHING missile ground-support equipment.

4. CONCLUSION

In its present stage of development, the communications pack No. 1 did not satisfactorily withstand, from a durability or reliability standpoint, the environmental conditions experienced during this program.

5. RECOMMENDATION

Modifications should be made to eliminate the problem areas encountered during this test in the communications pack No. 1. The modified unit should then be subjected to extensive road testing to evaluate its durability and reliability characteristics.

SUBMITTED:

Ray L. Wiles

RAY L. WILES
Test Director

REVIEWED:

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Development and Proof Services

APPENDICES

APPENDIX A

Correspondence

HEADQUARTERS
U. S. ARMY ORDNANCE MISSILE COMMAND
REDSTONE ARSENAL, ALABAMA

IN REPLY
REFER TO ORDXM-DS

11 April 1960

SUBJECT: Environmental Testing of PERSHING Communications Pack

TO: Commanding General
Aberdeen Proving Ground
Aberdeen, Maryland

ATTN: ORDBG-DPS

1. Reference is made to the visit on 2 March 1960 of the PERSHING Communications Pack Test Committee and discussions held at that time with representatives of Development and Proof Services.

2. Attached as an inclosure is a draft of the environmental test procedure for the PERSHING Communications Pack. A survey of available test facilities indicates that yours are the best suited for performance of the tests described in this procedure. These tests are now scheduled to begin about 1 June 1960.

3. It is requested that you review the attached test procedure and advise on the following:

a. Confirmation of the adequacy of your test facilities for performance of these tests.

b. Confirmation of the availability of your facilities for these tests, beginning on 1 June 1960 and extending for about three months. (It is estimated that climatic tests will require about five weeks; vibration tests, four weeks; and road tests, three weeks.)

c. The availability of instrumentation, including not only that required to measure the environment but also the items listed in paragraphs 2.1.2 through 2.1.11 of the test procedure.

d. An estimate of the amount of funding which must be provided by this Command. In formulating this estimate, assume the following:

(1) Your installation will provide labor necessary to operate the environmental equipment, to move and handle the equipment under test, and to assist in installing instrumentation.

(2) The equipment manufacturer will provide personnel to perform the tests.

(3) A small amount of shop-type support may be required to fabricate instrument mountings, to make simple repairs, etc.

(4) Instrumentation available at your installation will be used to the greatest extent possible.

4. Subject to your confirmation of the adequacy and availability of the facilities, this letter should be considered as a request for the use of the facilities required for performance of the tests indicated in the attached procedure.

FOR THE COMMANDER:

Fabian R. Andrews
FABIAN R. ANDREWS
Major, Ord Corps
Act Asst Adjutant General

1 Incl
AN/TRC-80 Environmental Test Procedure (30 Mar 60)

C O P Y/tsp

Mr Wiles/gl/42225

ORDBG-DPS-LU

MAY 27 1960

SUBJECT: Environmental Testing of PERSHING Communications Pack

TO: Commanding General
U. S. Army Ordnance Missile Command
Redstone Arsenal, Alabama
ATTN: ORDMX-DS

1. Testing of the PERSHING Communications Pack can be accomplished at Aberdeen Proving Ground in accordance with the basic requirements of letter ORDMX-DS, dated 11 April 1960, and its accompanying test procedure as amended at the Aberdeen Proving Ground meeting, 12 May 1960.

2. Instrumentation and facilities for establishing and measuring the environmental conditions are available at Aberdeen Proving Ground. With regard to the equipment requested in paragraph 3 of the referenced letter, a list of available equipment is inclosed.

3. The cost of conducting this program is estimated to be $85,000. This estimate is based on the following assumptions:

a. The environmental phases, paragraph 4.4.1 through 4.4.6 of the test procedure will be conducted as stated or as amended at the 12 May 1960 meeting at Aberdeen Proving Ground.

b. The table vibration test will include a resonance search plus testing as specified in ABMA-XPD 806, revision 1. The number of data stations will not exceed 40.

c. The road test will include road shock and vibration measurements over the Six-inch Washboard, Radial Washboard, Single corrugation hard surface and Cross-country test courses. The maximum number of information channels to be recorded is 24. A search will be made to determine the critical speeds for each course and data will be recorded at these speeds and where feasible at speeds below and above the critical points.

d. The cost has been based on total operation not to exceed 1000 miles. This in no way implies a suggested mileage.

C O P Y/tsp

ORDBG-DPS-LU MAY 27 1960

SUBJECT: Environmental Testing of PERSHING Communications Pack

4. During the 12 May 1960 meeting at Aberdeen Proving it was agreed that Aberdeen Proving Ground would suggest test courses for the road test and that ABMA would establish the required mileage. The courses selected are 1) a loop approximately 2 miles long and consisting of the Six-inch Washboard, Single Corrugation, Radial Washboard and connecting paved and gravel road links 2) smooth pavement, and 3) Cross-country.

5. Normal mileage for tanks and other tracked vehicles specified in OPM 60-115 is as follows:

Vehicle Under Test	Mileage, Courses				
	Paved	Gravel	Hill	Cross-Country	Total
Tanks	1000	1000	1000	1000	4000
Self-Propelled Artillery	1000	2000	1000	1000	5000
Armored Infantry Vehicle	1000	2000	1000	1000	5000

Since this test is to evaluate the communications pack and not the XM474 vehicle, the washboard and single corrugation courses were added. The above vehicle mileage values were given merely as a general guide since neither the life expectancy nor anticipated mileage on the communications pack is known.

FOR THE DIRECTOR:

1 Incl
a/s

/t/BENJAMIN S. GOODWIN
Associate Director

ARMY BALLISTIC MISSILE AGENCY
U. S. ARMY ORDNANCE MISSILE COMMAND
REDSTONE ARSENAL, ALABAMA MGHuth/mp/35489

IN REPLY
REFER TO ORDAB-IPP (ID 8161-00-60)

JUN 1 1960

SUBJECT: Environmental Testing of Communications Pack, PERSHING Missile System (ID 8161-00-60)

TO: Commanding General
Aberdeen Proving Ground
Aberdeen Proving Ground, Maryland
ATTN: . ORDBG-DPS

1. Your Agency is requested to provide the necessary services, facilities and materials to perform environmental testing of the PERSHING Communications Pack. This is to include, but not be limited to, the following:

a. Providing and operating the facilities and instrumentation for climatic, vibration and road testing of the PERSHING Communications Pack.

b. Providing the labor to move and handle, but not operate, equipment under test.

c. Providing a small amount of shop type support which may be required to fabricate instrument-mounting to make minor repair parts and similar items.

2. The period of performance for this testing is to be from 1 June 1960 through 30 September 1960, and the total cost is estimated to be $85,000.00.

3. This action is to be partially funded, with $20,000.00 to be provided as the FY 60 increment, and the balance (estimated as $65,000.00) to be provided in the first quarter of FY 61. Attached as Inclosure 1 is Work Order, Form AOS-20, in the amount of $20,000.00, identified as OMS Code 5210.12.127X2.84 and ID 8161-00-60, to cover the FY 60 increment.

ORDAB-IPP (ID 8161-00-60)
SUBJECT: Environmental Testing of Communications Pack, PERSHING Missile System (ID 8161-00-60)

4. It is anticipated that the $20,000.00 program authority furnished herewith is sufficient to cover performance during the period 1 June 1960 through 31 July 1960. This Agency is to be notified sufficiently in advance before additional program authority is required, so that there will be no interference with the work being performed.

5. The PERSHING Project Director's representative designated for this action is Capt. Archer, or his designated representative, SIGPG-DSE, Ft. Huachuca, Arizona.

6. Pursuant to AOMC Procedure C-2, 15 October 1959, this Agency, ATTN: ORDAB-IPP, will be advised within five (5) days the anticipated date and estimated amount of obligation, and the Status of Program Execution, RCS ORDXM-C-1006, of actual obligation.

7. This is a PERSHING Program requirement, and the use of the DO-A2 Priority Rating is authorized. For internal control purposes, ID Number 8161-00-60 has been assigned, and will be shown on correspondence and related documents.

FOR THE COMMANDER:

John B. Parker
for J. A. MULLER
Chief, Procurement Operations Branch
Industrial Division

1 Incl
AOS-20

Copy furnished:
OCO, ATTN: ORDPM w/o Incl

C O P Y/tsp

ORDXM-DS 1 AUG 1960

SUBJECT: Potential Health Hazards of the PERSHING Communications Pack

THRU: Chief of Ordnance
Department of the Army
Washington 25, D. C.

TO: The Surgeon General
Department of the Army
Washington 25, D. C.
ATTN: MEDCE-OH

1. Reference:

a. AR 40-583, Hazards to Health from Microwave Energy, 9 September 1958, with Change 2.

b. TAG Letter, 23 May 1960, AGAM-P(M) 471.6 (16 May 60) SIGFO, Subject: Program for RF Field Strength Measurements (U).

2. Both calculated and measured results indicate that operators of the PERSHING Communications Pack, AN/TRC-80, may be exposed to microwave radiation of intensity greater than the safe level of 10 mw/cm^2. In accordance with the referenced regulation, it is requested that the U. S. Army Environmental Health Laboratory measure and evaluate this potential hazard.

3. An engineering model of the Communications Pack is presently undergoing environmental tests at Aberdeen Proving Ground, Maryland. It is requested that the radiation survey be made while the equipment is at that installation. The date for performing the survey should be established by direct coordination between Environmental Health Laboratory personnel and those of the U. S. Army Ordnance Human Engineering Laboratory and of the Automotive Engineering Laboratory, Development and Proof Services, Aberdeen Proving Ground. (The last-named laboratory has project control for testing of the AN/TRC-80 at APG.)

COPY/tsp

ORDXM-DS
SUBJECT: Potential Health Hazards of the PERSHING Communications Pack

4. The AN/TRC-80 will eventually become a standard type Signal Corps equipment. In view of this it is suggested that your tests and evaluation be coordinated with the Office of the Chief Signal Officer.

FOR THE COMMANDER:

W. T. WILSON
Captain, AGC
Asst Adjutant General

APPENDIX B

Laboratory Reports

ABERDEEN PROVING GROUND, MARYLAND

AUTOMOTIVE ENGINEERING LABORATORY REPORT

PROJECT NO: 127X/160

DATE: 10 October 1960 REPORT NO: 60-54

ENVIRONMENTAL TEST OF COMMUNICATIONS PACK

PERSHING MISSILE SYSTEM AN/TRC-80

DATES OF TEST: 1 August thru 1 September 1960

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INCLOSURES

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1. INTRODUCTION

1.1 Objective

This test was conducted to determine the performance of the Communication Pack, Pershing Missile System, designated AN/TRC-80 under the following extreme environmental conditions:

a. Operation at +125°F

b. Storage at +160°F

c. Operation at -25°F

d. Operation at -65°F

e. Operation after storage at +80°F at 90 - 95% humidity

f. Antenna raising and lowering with 0.2 inch of ice on exposed surfaces.

Aberdeen Proving Ground's function by agreement was limited to:

a. Providing and operating the facilities and instrumentation for climatic tests.

b. Providing labor to move and handle, but not operate, the equipment under test.

c. Provide minor shop support for small fabrication and repair.

2. RESULTS

2.1 Operation at 125°F

2.1.1 Engine Generator

This unit operated satisfactorily at 125°F. Maximum oil temperature of 265°F and spark plug gasket temperature of 400°F indicate that the engine was able to maintain safe operating temperatures. There was no unusual hunting or any inability to supply the required power to the load. Even though fuel temperatures rose to 173°F there were no indications of vapor lock or any of the other engine malfunctions normally expected at high fuel

temperature. Engine generator temperatures are given in Figure 1.

2.1.2 Air Conditioning System

Both units stopped working less than 1/2 hour after the operational test was begun. Subsequent analysis of the recorded temperatures and air circulation patterns showed that recirculation of condenser cooling air raised the temperature of the protective thermal cutout on the compressor motor high enough to caused it to cut the compressor off. Operation was restored by bypassing this cutout; but adequate cooling was never achieved. See Figure 2. Subsequently, various louvre modifications were made to try and improve condenser cooling by 1) reducing back pressure on the condenser cooling fan and 2) elimination of recirculation of hot air out of the condensers into the condenser inlet grille. The final modification appears to give satisfactory results. Even with the air conditioners working at peak efficiency, there is still the question of whether they possess the capacity to hold the temperature in the personnel compartment of the hut to comfortable levels. Air conditioner temperatures are shown in Figures 3 and 4.

2.1.3 Communications Equipment Proper

Evaluation of the performance of this equipment is beyond the scope of this report and will be given elsewhere. It can be stated that its performance did not meet specifications. Typical operational temperatures are shown in Figure 6.

2.1.4 The Antenna

The tests of this component consisted of determining whether the high temperature would add any complications to the task of taking it from a folded, stored condition to the fully erected, inflated, transmitting, position. No problems were encountered at this temperature except that certain metal surfaces were uncomfortably hot to the touch. Figure 5 shows a general view of the Communications Pack with the antenna elevated.

2.1.5 Shelter Proper

No operation involved. No signs of distress noted except that roof and antenna compartment temperatures exceeded 160°F while the simulated solar radiation was applied to the roof.

2.2 160°F Soak

Inspection of the Pershing Communication Pack after the 12 hour soak at +160°F disclosed small holes in the antenna bag probably caused by pressure on the sharp corners of the antenna blower housing and not attributable to the temperature. The top of the pack was sagging in the area over the operator's compartment. This failure was thought to be the result of shearing of the bond between the aluminum roof and the pliofoam insulation. Further checking revealed that the bond held but the shearing occurred in the pliofoam layers.

2.3 Test at -25°F

2.3.1 Engine Generator

The engine started easily in ten seconds of cranking. It was necessary to heat the throttle control motor for ten minutes to thaw it out. This was done before the engine was started. All engine temperatures stabilized within one hour. The engine experienced no difficulty in handling the load imposed by the power requirements of the pack. Time-temperature curves are given in Figure 7.

2.3.2 Air Conditioners

At this temperature the heaters in the air conditioners were used to attempt to elevate ambient temperatures in the hut to comfortable limits. The heaters failed to work satisfactorily. Only intermittent operation was achieved. Two hours were required to raise the temperature within the hut to comfortable levels (see Figures 8 and 9). Because of the unsatisfactory operation of the heaters and also, because various operational difficulties made it necessary to open and close the personnel door several times, it is impossible to arrive at any conclusions relative to the capacity of the heaters.

2.3.3 Communications Equipment

The comments made in Section 2.1.3 apply here also. Temperatures are given in Figure 10.

2.3.4 Antenna

Antenna erection was successfully accomplished. The stiffness of the bag and the bulk of the arctic mittens significantly increased the time required to perform this task. It was necessary to remove the mittens and use anti-contact gloves to attach the bag to the frame. When the antenna was lowered after being elevated for six hours, the task was complicated by ice and frost which had collected on its surface. The bag was very stiff and was folded with great difficulty. Approximately 30 minutes were required to secure the antenna. Figures 11 thru 13 show various stages of the antenna lowering operation.

2.4. Tests at -65°F

2.4.1 Engine-Generator

On two separate occasions, the engine was started within 30 minutes after the engine heater was turned on. However, before each attempt, extensive repairs had to be made to the engine heater. A new float bowl, and a new coil were installed before the first start. Before the second start, over two hours was required to get the heater running. Engine temperatures during heater operation and after the engine was started are shown in Figure 14. After 3-1/2 hours operation at -65°F the engine generator suddenly started backfiring and sputtering and finally stopped. The trouble was

traced to a broken operating lever on the fuel pump. With the fuel pump not working, the fuel mixture from the carburetor rapidly leaned out causing the misfiring noted prior to the engine stoppage. Further investigation showed that the generator drive shaft was also broken possibly because of abnormal stresses imposed by the engine back fires.

2.4.2 Air Conditioners

Heater operation was essentially the same as at -25°F (see Figures 15 and 16).

2.4.3 Communications Equipment

This equipment also had its usual troubles. In addition the teletype did not work at all and the power amplifier blower inlet repeatedly became covered with frost. Everytime this occurred, the resulting loss of air circulation activated the safety device which turned off the amplifier (see Figure 17).

2.4.4 Antenna

The antenna was elevated without difficulty after being heated for 90 minutes. The lowest temperature at this point was -1°F (Figure 18). After 3-1/2 hours, heat was again applied in preparation for lowering the antenna. After one half hour it became apparent that the heater output (60,000 Btu) was inadequate. Antenna skin temperatures stabilized at -25°F on the cold side and +50°F on the warm side (Figure 18). An attempt to lower the antenna was abandoned when it became obvious that even though the bag might be flexible enough to be folded, the outer torus which had received no direct heat was still completely stiff.

2.4.5 Hut

Thermal stresses caused the floor of the personnel compartment to bridge in several places. The door warped enough to make it very difficult to completely close it.

2.5 Tests at +80°F and 95 - 100% Relative Humidity After 96 Hour Soak at Those Conditions

2.5.1 Engine Generator

This unit started without difficulty and showed no adverse effects from the soak.

2.5.2 Air Conditioners

No new problems resulting from this environment.

2.5.3 Communications Equipment

Problem areas previously discovered were apparently aggravated

by the high humidity. No new difficulties were encountered.

2.5.4 Antenna

This unit was not involved in the high humidity test.

2.5.5 Hut

No problems.

Temperature and humidity curves before and during the test are shown in Figures 19 thru 21.

2.6 Antenna Raising and Lowering with 0.2 Inch of Ice on Exposed Surfaces

2.6.1 Raising

Antenna elevation was normal. All doors and parts were opened without difficulty. Figures 22 and 23 show views of the pack with the ice deposit built up. Figure 24 shows the antenna after elevation.

2.6.2 Lowering

The ice accumulation on the antenna (see Figures 25 and 26) could not be removed by inflating and deflating the bag. The ice was removed by striking the bag with various objects. It was necessary to use a screw driver to chip ice from all the joints in the supporting frame work. One hour was required to get the bag folded. The ice accumulation on the platform immobilized the rotating mechanism. Therefore, the antenna could not be turned to the proper position to permit the platform to be lowered into the antenna compartment.

After the room temperature was raised to normal ambient levels, the personnel compartment floor was found to be flooded with water. As the ice melted in the antenna compartment it ran into the engine compartment. Since the drain plug had not been removed, the water seeped under the bulkhead and entered the personnel compartment.

2.7 General Results

Table I shows a list of the deficiencies that occurred during the test. In those cases where the cause of the deficiency or the correction made is known, that information is also given.

Table III is copied from the log book that was kept during the tests. Many of the apparently erratic changes in temperature indicated on the curve sheets can be accounted for by reference to this log book.

3. DETAILS OF TEST

3.1 Description of Material

The Pershing Communications Pack is a quick reaction, transportable, tropospheric scatter communication system. The system provides simultaneous transmission of one full duplex voice channel and one half duplex teletype channel. The unit can transmit on frequencies from 1700 mc to 2400 mc. Transmission waves are frequency modulated. The system is completely self sustaining.

The major components of the pack are, the engine-generator, the air conditioning system, the communications equipment proper, the antenna, and the hut itself.

3.2 Procedure

3.2.1 Operation at 125°F, -25°F and -65°F

The Communications Pack was placed in the traveling position and soaked at the test temperature for 12 hours. The engine and personnel compartment doors were left open to insure that the engine and communications equipment were thoroughly soaked at the test temperature. Infrared lamps were used to simulate solar radiation during the last two hours of the soak period and during two hours of the operational test at 125°F. The operational test included the following phases:

a. Start engine.

b. Start air conditioners.

c. Turn on electronic equipment (transmitter output absorbed in dummy antenna load).

d. Conduct series of tests on communications equipment.

e. Raise and inflate antenna. Rotate.

f. Deflate antenna and return to stored position.

g. At -65°F, use of winterization kits added the intermediate steps of operating engine and antenna heaters.

This series of tests was run on the premise that failure or malfunction of any component would not necessarily terminate the test. Testing of other operable components would continue while the inoperative unit was being repaired or adjusted. The objective of the test was to obtain the maximum

... of information on operation of as many components as possible in each environment. This arrangement made it difficult to accomplish some of the objectives required by the original test directive. For example, the constant need for repairs and adjustments to the air conditioners and communications equipment meant that the personnel door was constantly being opened and closed. Under these conditions, evaluation of the air conditioners was impossible.

Periodic recordings were made of temperatures in the following locations: Engine, air conditioner, personnel compartment, and communications equipment. A complete thermocouple list is given in Table II. Temperature-time curves were drawn for each component for each test temperature.

3.2.2 Storage at +160°F

The AN/TRC-80 Communications Terminal was soaked at +160°F for 12 hours, then returned to ambient temperature, inspected and put through the operational test.

3.2.3 Humidity Test

This test was conducted in accordance with the procedure specified in MIL-STD-202A, Test Methods for Electronic and Electrical Component Parts, Method 103A, Humidity (Steady State) Condition B, except that the test temperature was 80°F instead of 104°F.

3.2.4 Icing Test

The terminal in transit condition was placed in a cold room at approximately +20°F. A layer of ice approximately 0.2 inch thick was built up on the top and sides of the terminal by repeatedly wetting these surfaces with a fine water spray and allowing the water to freeze. All doors and hatches were opened and closed. The antenna was raised and inflated. After a layer of ice approximately 0.2 inch thick was built up on the surface of the antenna, the antenna support arms and the antenna platform, an attempt was made to lower the antenna and return it to the transit condition.

SUBMITTED:

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TABLE I

DEFICIENCIES

Date	Amb. Cond.	Unit	Description of Failure
24 June	+125	A/C	Condenser temp. exceeded safe limits causing thermal relay to cut off compressor motor. Air recirculation.
24 June	+125	Switch Board Console	Stopped working
24 June	+125	Power Amp	Blew fuse
24 June	+125	Teletype	Carriage return sluggish - wrong adjustment.
24 June	+125	RF Equip.	Signal-to-noise ratio exceeded specs.
21 June	Normal Amb.	Eng.-Gen.	Governor prevented engine from idling - repaired by Belvoir personnel.
27 June	Normal Amb.	Mobilizers	Mounting holes did not line up with holes in hut. Corrected by enlarging holes. Low fluid in hydraulic sump of rear unit.
18 July	Normal Amb.	Eng.-Gen.	New cut-off switch installed.
19 July	Normal Amb.	Eng.-Gen.	Starter solenoid sticking.
27 July	Normal Amb.	Mobilizers	Broke tie rods while maneuvering unit.
27 July	Normal Amb.	Eng.-Gen.	Fuel supply line connected to tank vent instead of fuel outlet.
1 Aug.	+125°F	A/C	Cutout activated by excessive temp. in condenser. Cause - air recirculation.
1 Aug.	+125	A/C	Martin Console failed - continually kicks off circuit breaker.
1 Aug.	+125	Eng.-Gen.	Float sticks.
3 Aug.	Normal Amb.	Eng.-Gen.	Muffler burned out. Heater flooded because of leaky float.
2 Aug.	+160°F	Hut	Roof sagged over operator's compartment.
5 Aug.	-25°F	Eng.-Gen.	Throttle motor frozen. Heater coil failed.
		Air Cond.	Heaters only operate intermittently.
		Commo. Equip.	Malfunction in Cavity "J".

DEFICIENCIES (CONT.)

Date	Amb. Cond.	Unit	Description of Failure
8 Aug.	-65°F	Commo. Equip.	Power amplifier malfunction. Teletype failed to work - motor would not start.
9 Aug.	-65°F	A/C	Necessary to apply heat to heater blower motor.
9 Aug.	-65°F	Commo. Equip.	Power amplifier inlet frosted up. Resulting loss of air caused safety switch to turn PA off. Teletype motor would not start.
9 Aug.	-65°F	Eng.-Gen.	Fan on heater frozen. Starter solenoid frozen. Fuel pump activating lever broke. Resulting lean mixture caused engine to backfire heavily. Abnormal stresses imposed on generator drive shaft caused it to break.
9 Aug.	-65°F	Hut	Personnel door warped. Personnel compartment floor bulged in several placed.
9 Aug.	-65°F	Antenna	Heater output insufficient to heat inflated antenna. No heat supplied to outer torus.
20 Aug.	80°F After Test at High Humidity	Eng.-Gen.	Teeth stripped on cooling fan drive gear.
23 Aug.	Test Icing	Antenna	Ice immobilized antenna rotating mechanism.
24 Aug.	After Icing	Eng.-Gen. Hut	Governor failed. Water from melting ice seeped from eng-gen. compartment into personnel compartment.
25 Aug.	+110°F	Eng.-Gen.	Oil leak from breather valve.
1 Sep.	Normal Amb.	Eng.-Gen.	Magneto malfunction. Choke sticking.
30 Aug.	Rain Tests	Antenna	Elevating mechanism failed.

TABLE II

TEMPERATURES RECORDED DURING ENVIRONMENTAL TESTS
OF PERSHING COMMUNICATIONS PACK AN/TRC-80

1. Air Conditioner Evaporator Inlet - Bottom Unit
2. Air Conditioner Evaporator Inlet - Top Unit
3. Air Conditioner Evaporator Outlet - Bottom Unit
4. Air Conditioner Evaporator Outlet - Top Unit
5. Air Leaving Rack One - Measured in Front of Cavities on T310-2
6. Air Leaving Rack Three - Measured Over Top of Mixer No. 2, 708E, No. 2
7. Air Leaving Rack Four - Measured in Front of Cavities on C50-1A
8. Air Leaving Rack Five - Measured in Front of the Tubes on the Oscillator Module.
9. Power Amplifier Cooling Air Out
10. Power Amplifier Panel Surface Temperature Operator's Side
11. Air Into Blower - Rack No. 4
12. Surface Temperature - Left Side of Teletype Case
13.
14. Ambient Temperature Below Desk
15. Ambient Temperature at Operator's Head Height
16. V2 Tube Shield on Q50-1, IF. Preamplifier in Rack No. 5
17. Engine-Generator Compartment Blower Inlet
18. Engine-Generator Compartment Wall Temperature Measured Between Wall and Insulation at Point Within Two Inches of Exhaust Outlet
19. Engine Cooling Air Inlet
20. Engine Cooling Air Outlet - Right Side
21. Engine Cooling Air Outlet - Left Side
22. Engine Combustion Air - Measured After Air Cleaner
23. Engine Oil - Measured in Oil Pan
24. Cylinder Head - Measured Under Spark Plug - Rt. Cyl.
25. Cylinder Head - Measured Under Spark Plug - Lt. Cyl.
26.
27. Engine-Generator Compartment Wall Temperature Under Insulation - Measured on Rt. Side of Compartment
28. Ambient Temperature in Gasoline Tank Compartment
29. Ambient Between Battery Cells
30. Battery Case - Engine Side
31. Fuel Temperature in Main Tank
32. Antenna Compartment Floor Over Engine-Generator
33. Antenna Compartment Floor Over Gasoline Tank Compartment
34. Hot Air Leaving Engine Heater
35. Fuel at Carburetor

TABLE II (CONT.)

36. Hot Air Leaving Antenna Heater
37. Hot Air Leaving Antenna Heater Duct
38. Cooling Air to Air Conditioner Condenser - Front Unit
39.
40. Antenna Bag
41. Antenna Bag
42. Antenna Bag
43. Antenna Bag
44. Air Conditioner Overload Cutout Relay - Front Unit
45. Air Conditioner Overload Cutout Relay - Rear Unit
46. Air Conditioner Compressor Suction Line - Rear Unit
47. Air Space Behind Condensers
48. Cooling Air Out of Air Conditioner Condenser - Front Unit

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

ENGINE TEMPERATURES DURING OPERATION AT +125°F

DATE OF TEST: 1 August 1960

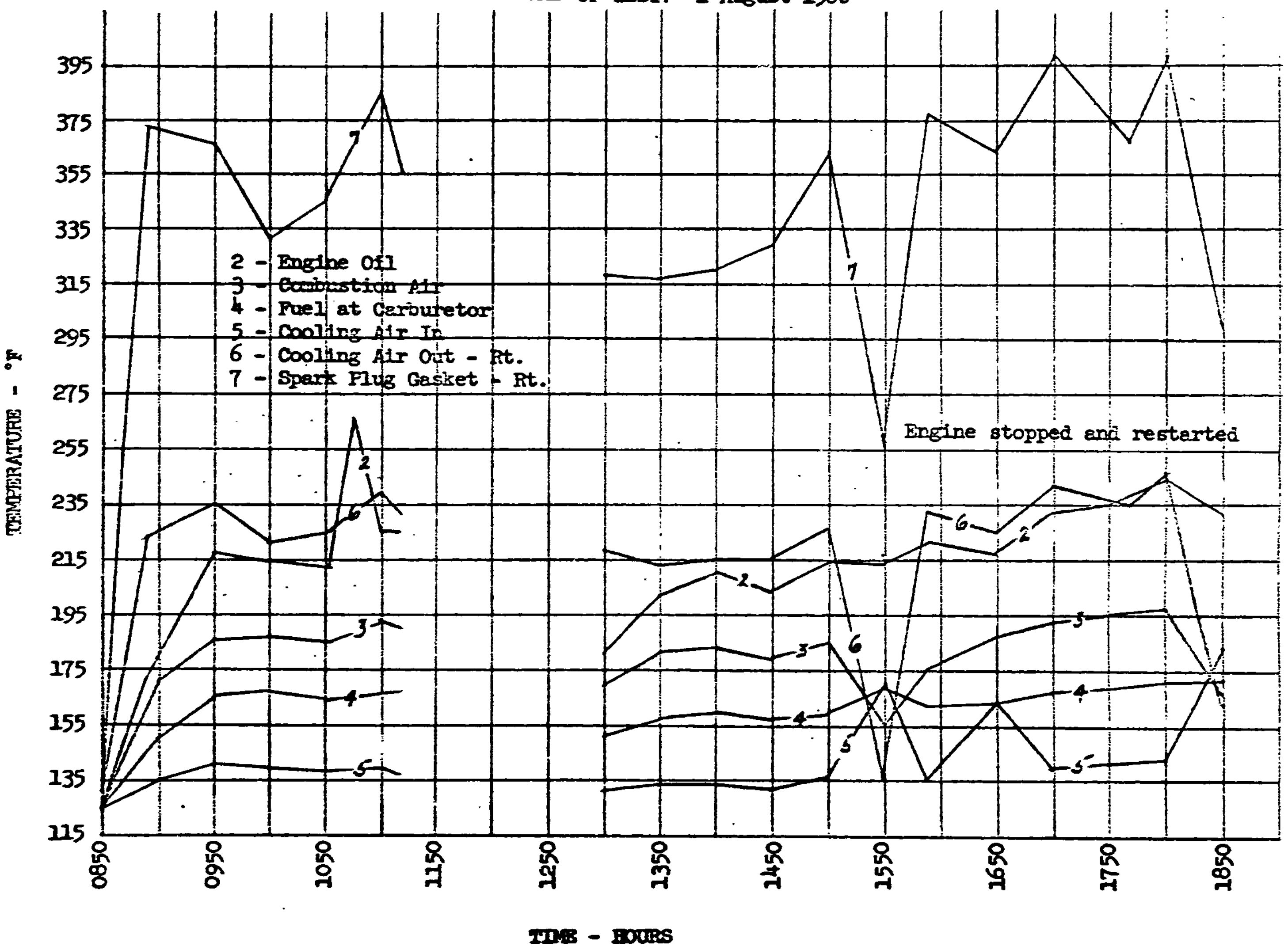

FIGURE 1: Engine-Generator Temperatures During Operation at +125°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

TEMPERATURES IN PERSONNEL COMPARTMENT DURING OPERATION AT +125°F

DATE OF TEST: 1 August 1960

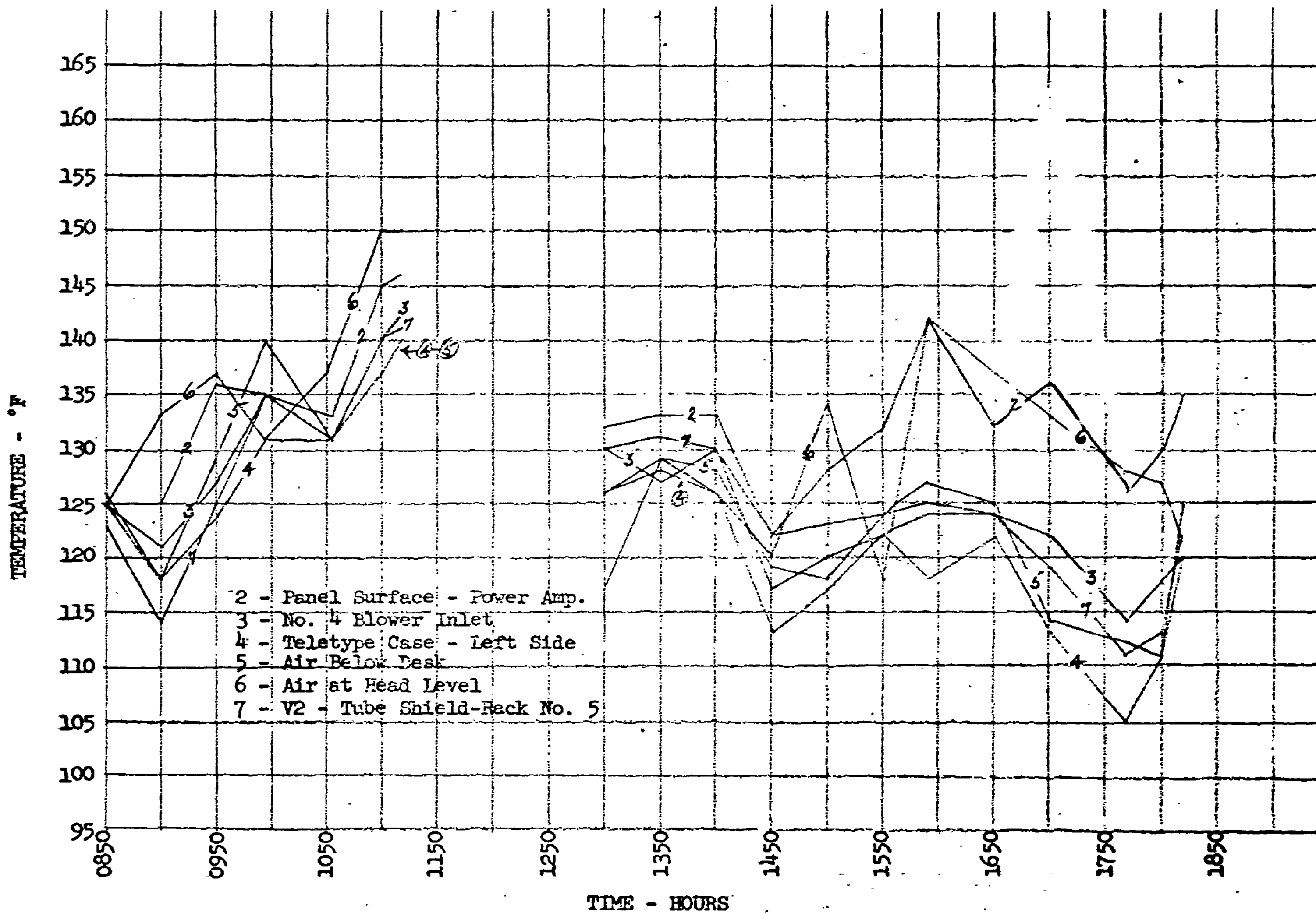

FIGURE 2: Personnel Compartment Temperatures During Operation at +125°F

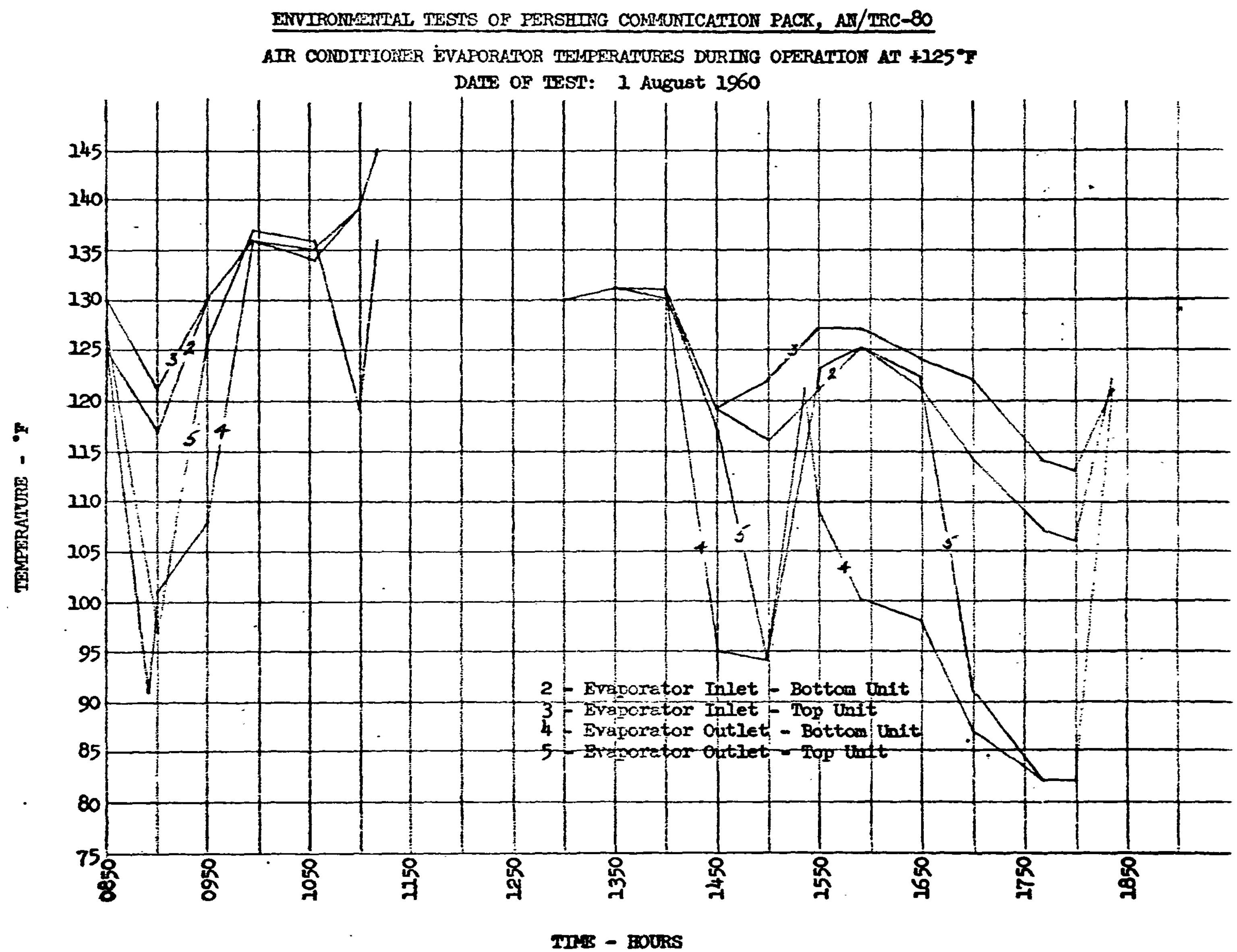

FIGURE 3: Air Conditioner Evaporator Temperatures During Operation at +125°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

AIR CONDITIONER CONDENSER TEMPERATURES DURING OPERATION AT +125°F

DATE OF TEST: 1 August 1960

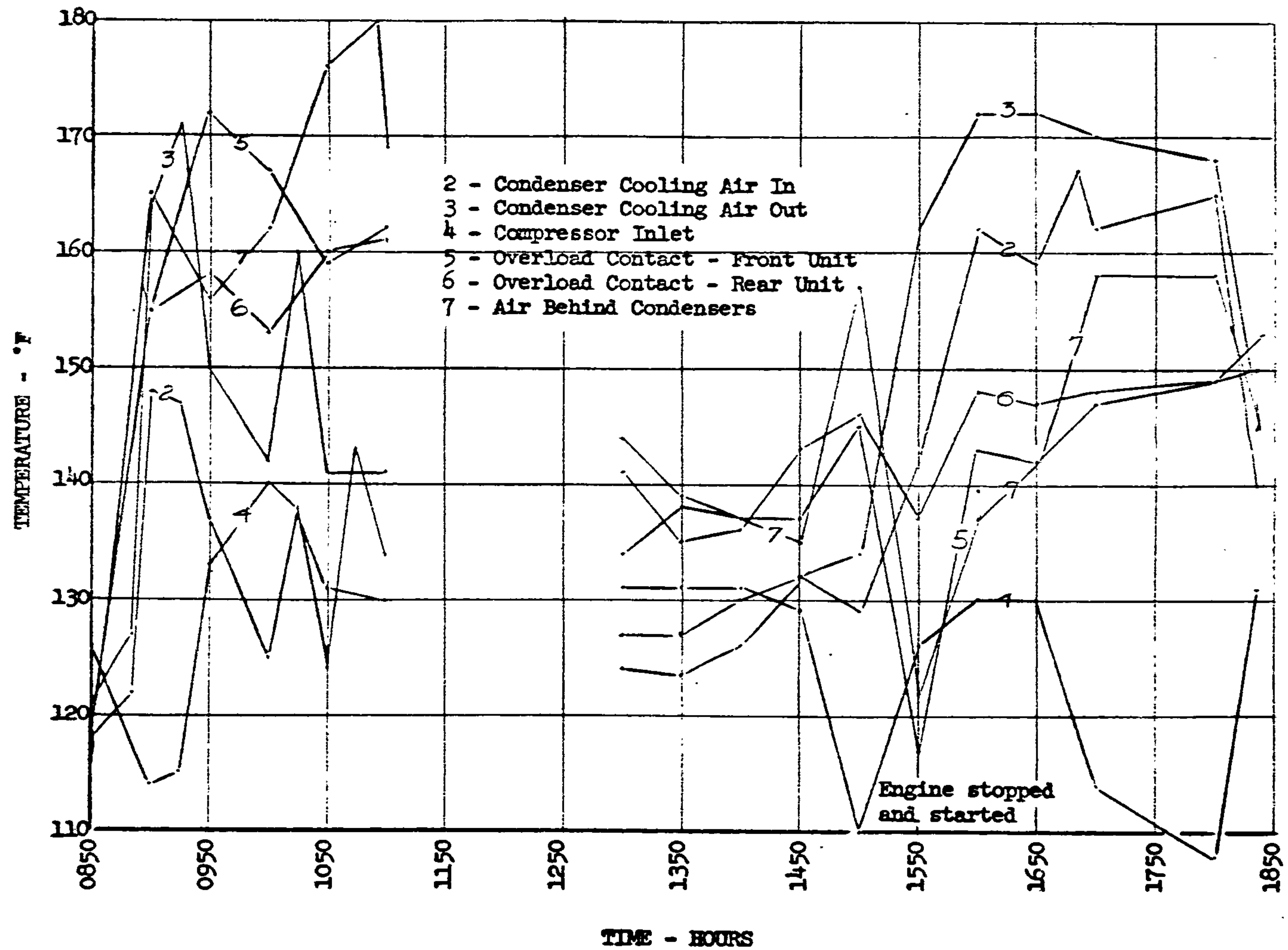

FIGURE 4: Air Conditioner Condenser Temperatures During Operation at +125°F

FIGURE 5: General View of Communications Pack Installed in Climatic Chamber

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

COMMUNICATIONS EQUIPMENT TEMPERATURES DURING OPERATION AT +125°F

DATE OF TEST: 1 August 1960

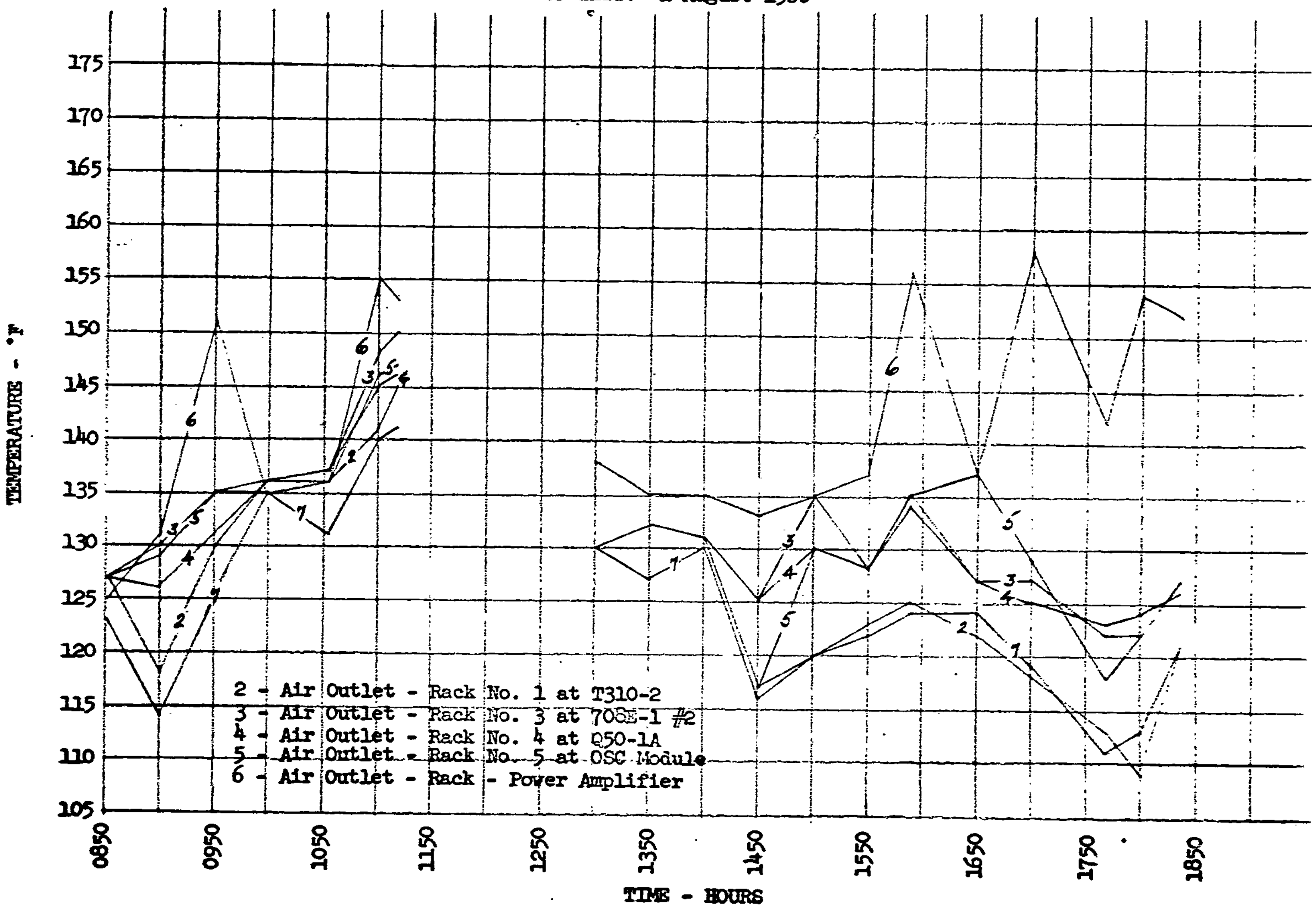

FIGURE 6: Communications Equipment Temperatures During Operation at +125°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

ENGINE TEMPERATURES DURING TEST AT -25°F

DATE OF TEST: 5 August 1960

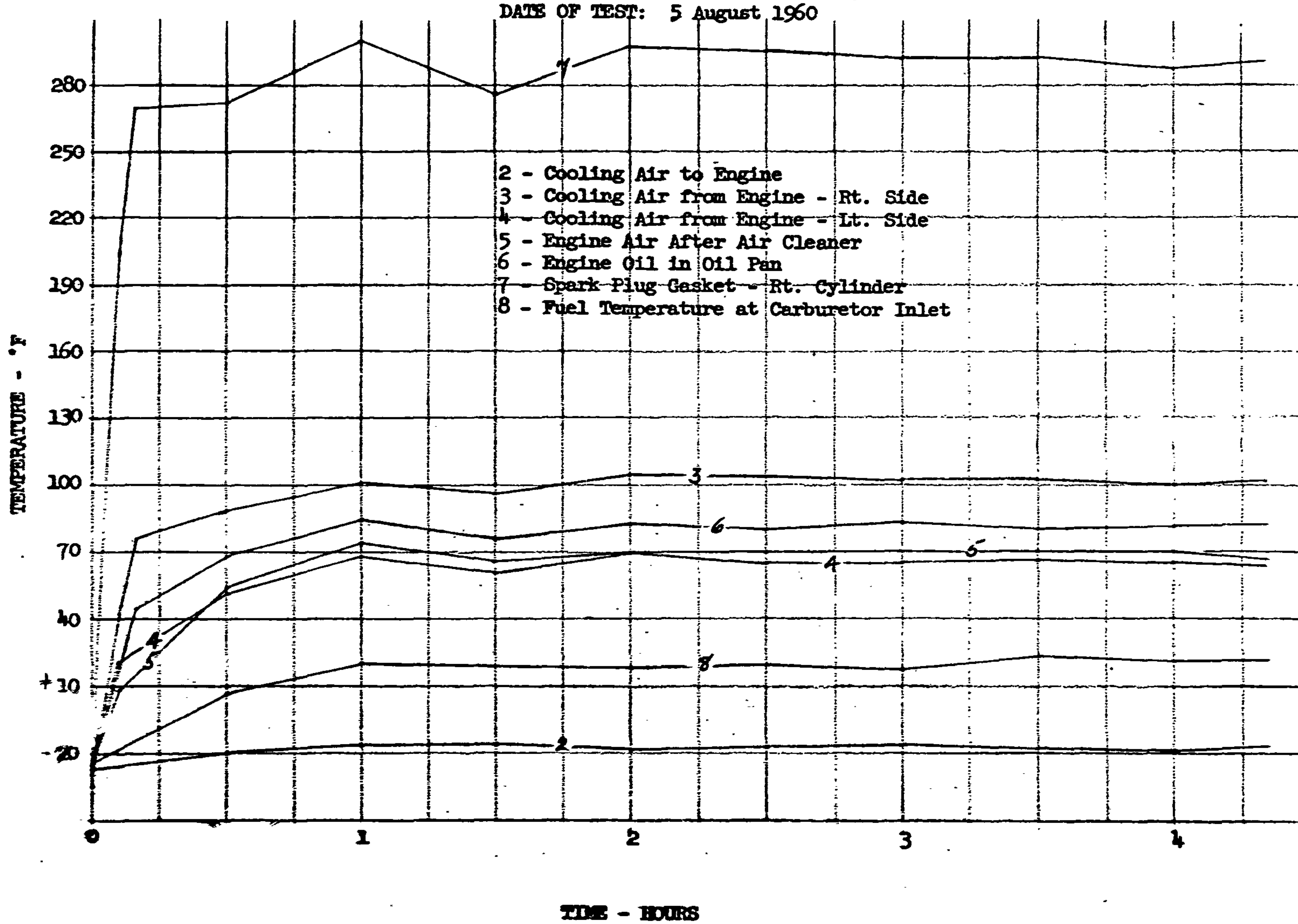

FIGURE 7: Engine-Generator Temperatures During Operation at -25°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

PERSONNEL HEATER TEMPERATURES AT -25°F

DATE OF TEST: 5 August 1960

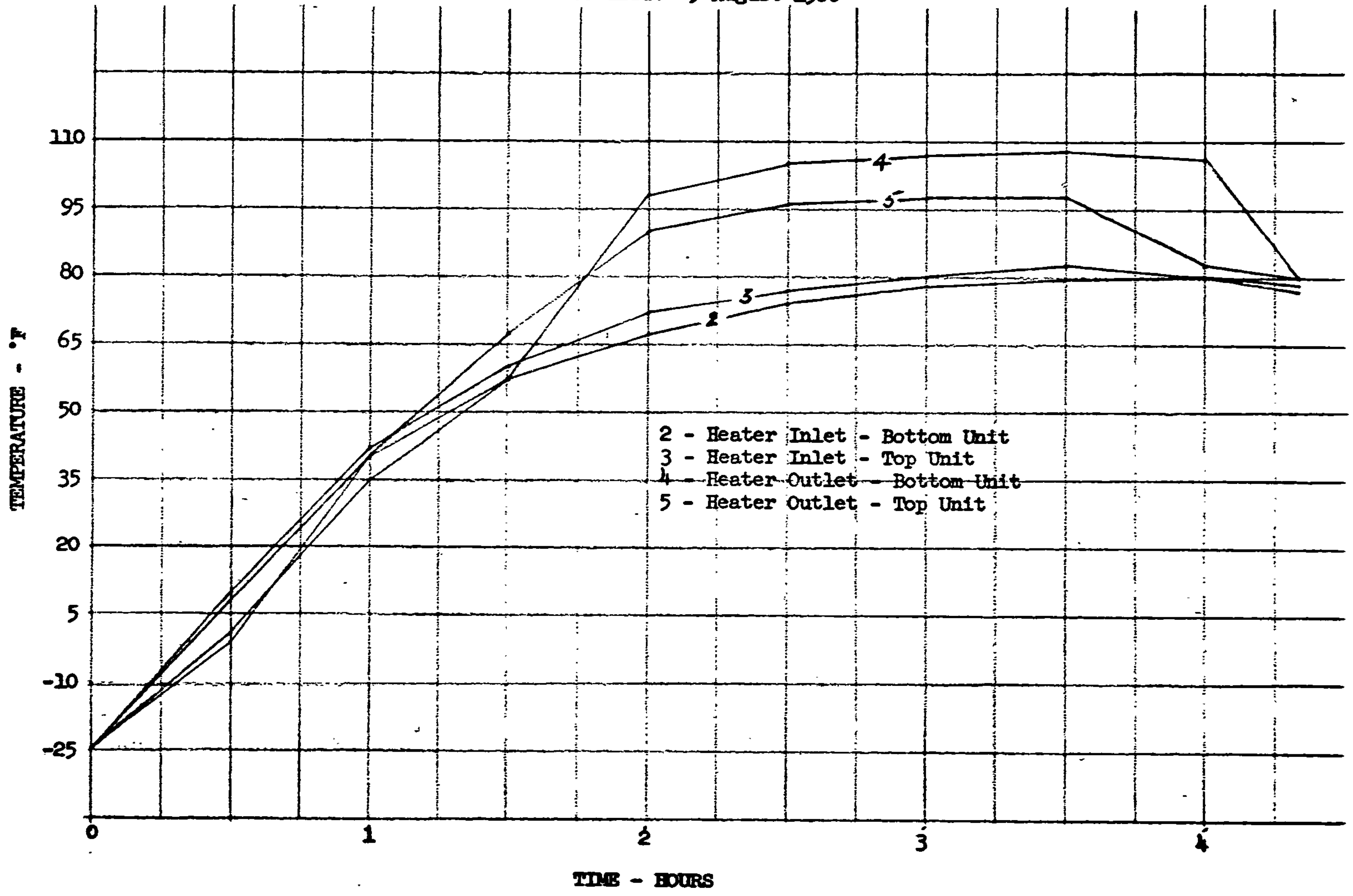

FIGURE 8: Personnel Compartment Heater Temperatures During Operation at -25°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

TEMPERATURES IN PERSONNEL COMPARTMENT DURING TEST AT -25°F

DATE OF TEST: 5 August 1960

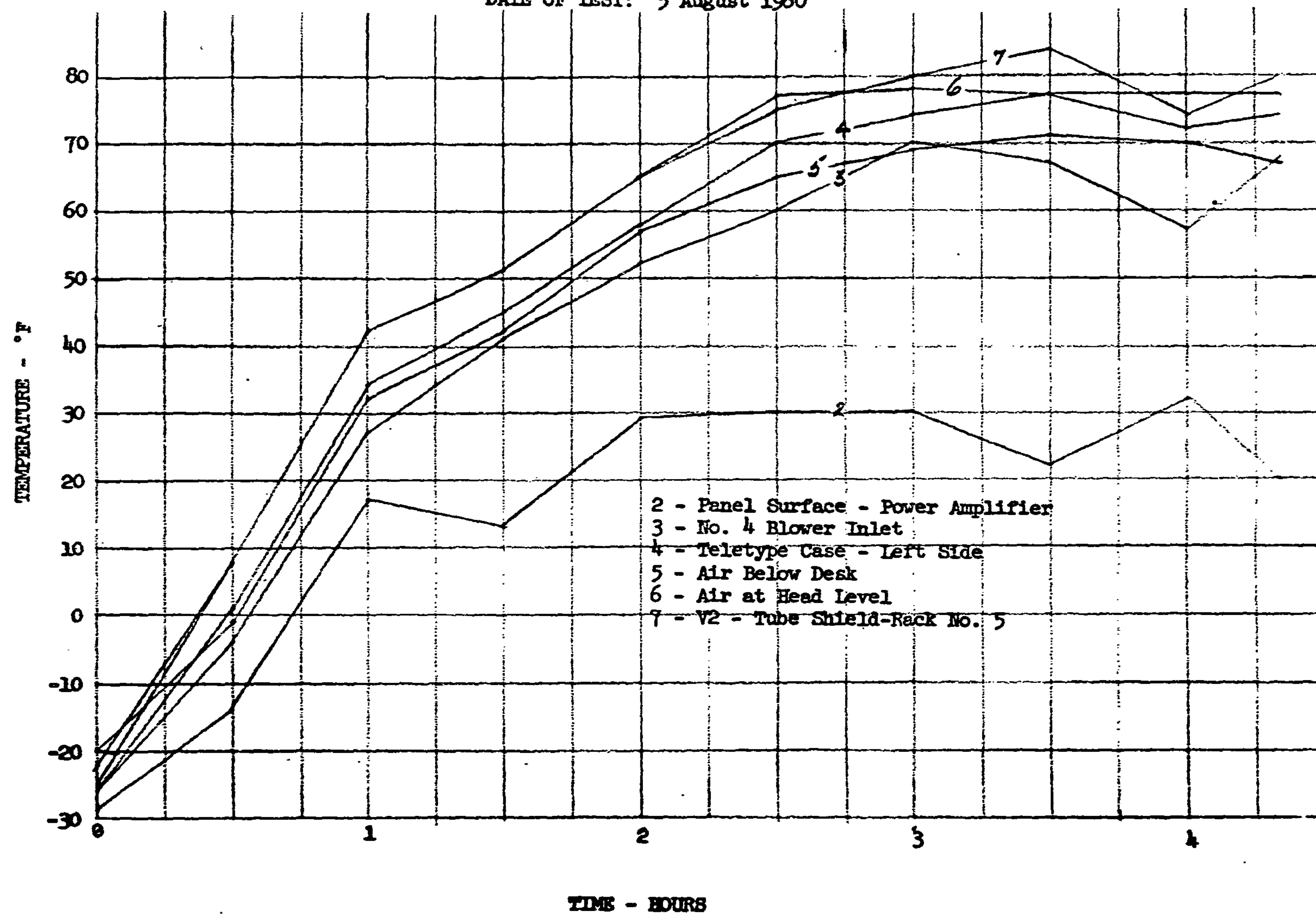

FIGURE 9: Personnel Compartment Temperatures During Operation at -25°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

COMMUNICATIONS EQUIPMENT TEMPERATURES DURING TEST AT -25°F

DATE OF TEST: 5 August 1960

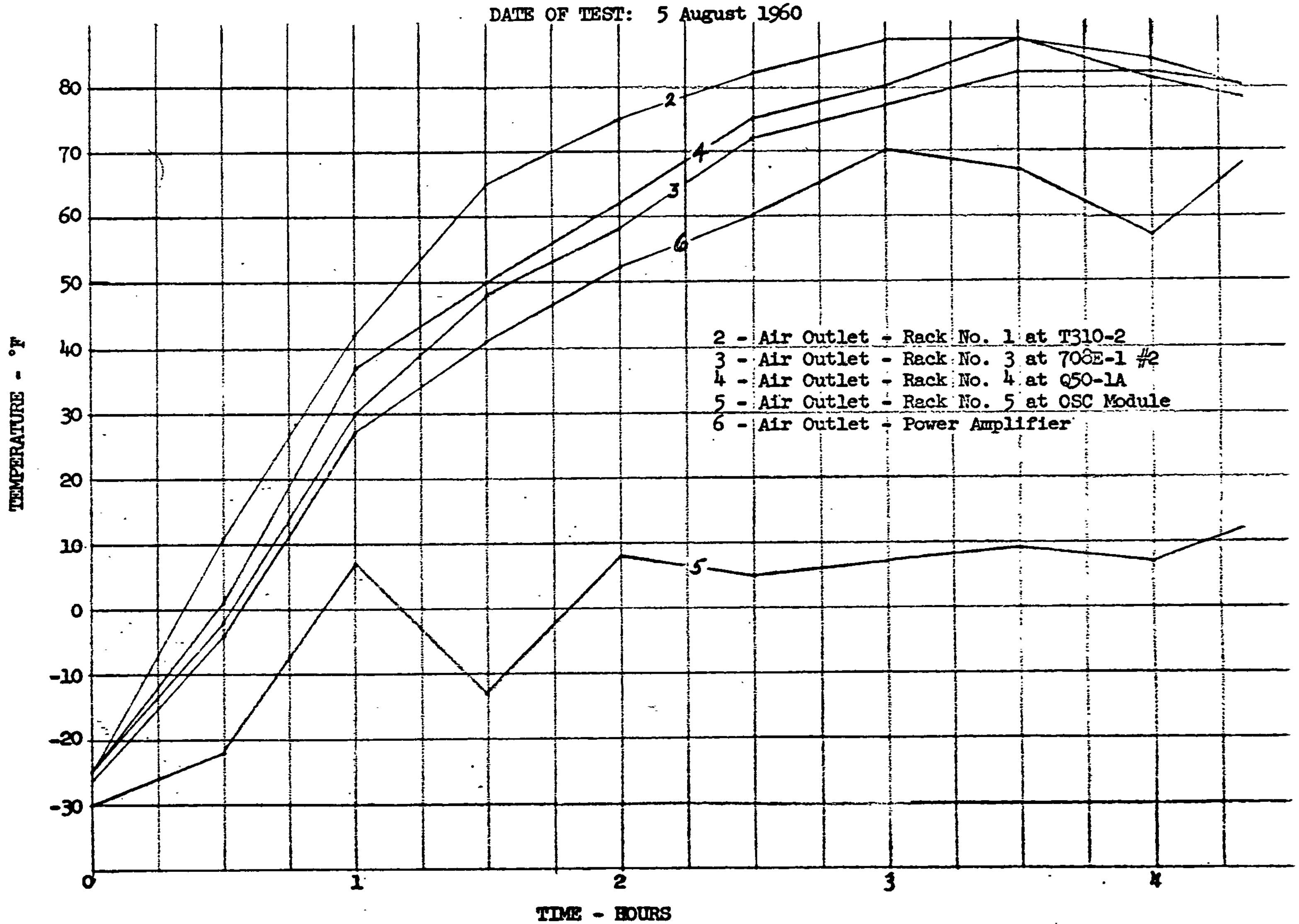

FIGURE 10: Communications Equipment Temperatures During Operation at -25°F

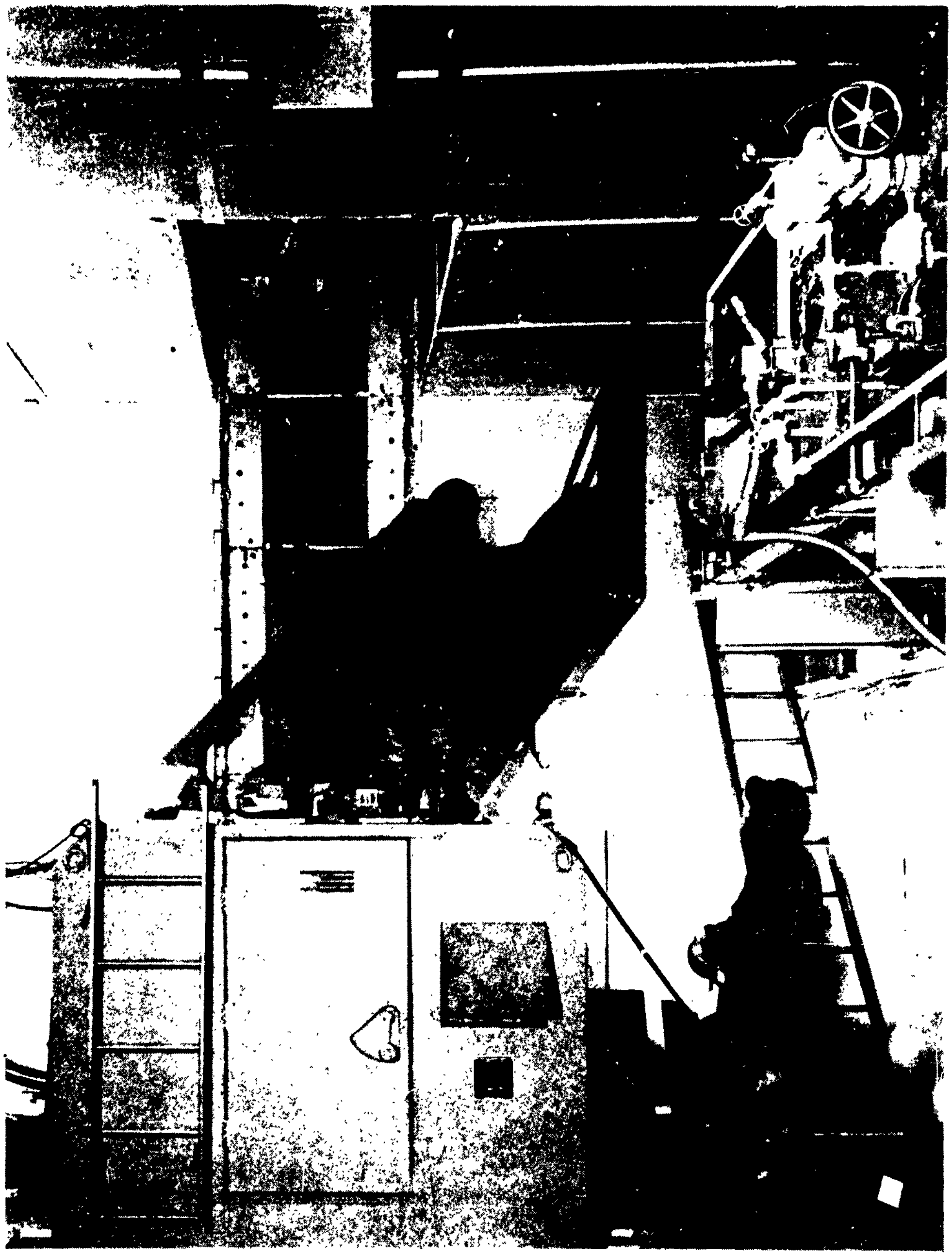

FIGURE 11: Antenna Being Detached from Supporting Frame in Preparation for Storage at -25°F

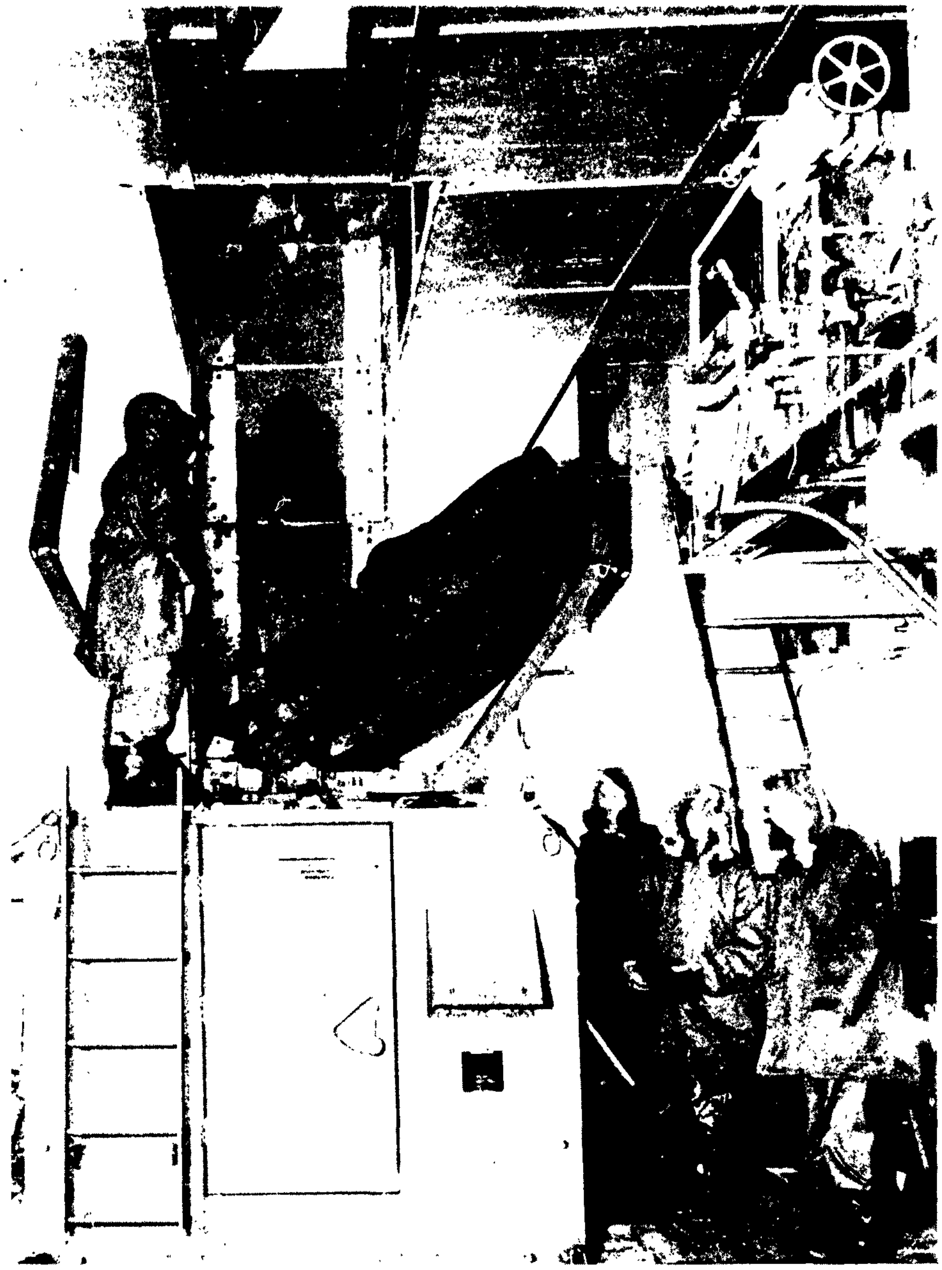

FIGURE 12: Antenna Being Detached from Supporting Frame in Preparation for Storage at -25°F

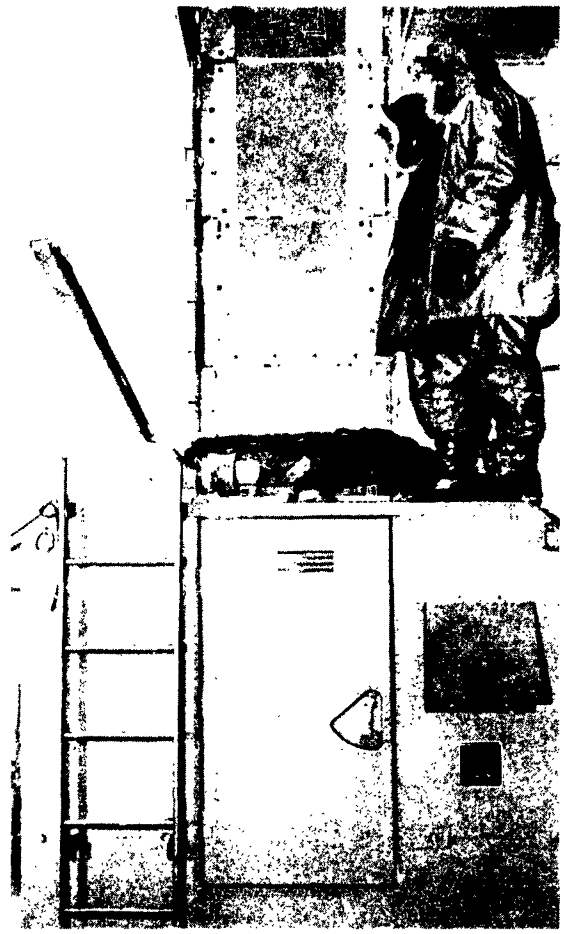

FIGURE 13: Antenna Folded and Ready to be Lowered into Antenna Compartment

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

ENGINE TEMPERATURES DURING OPERATION AT -65°F

DATE OF TEST: 9 August 1960

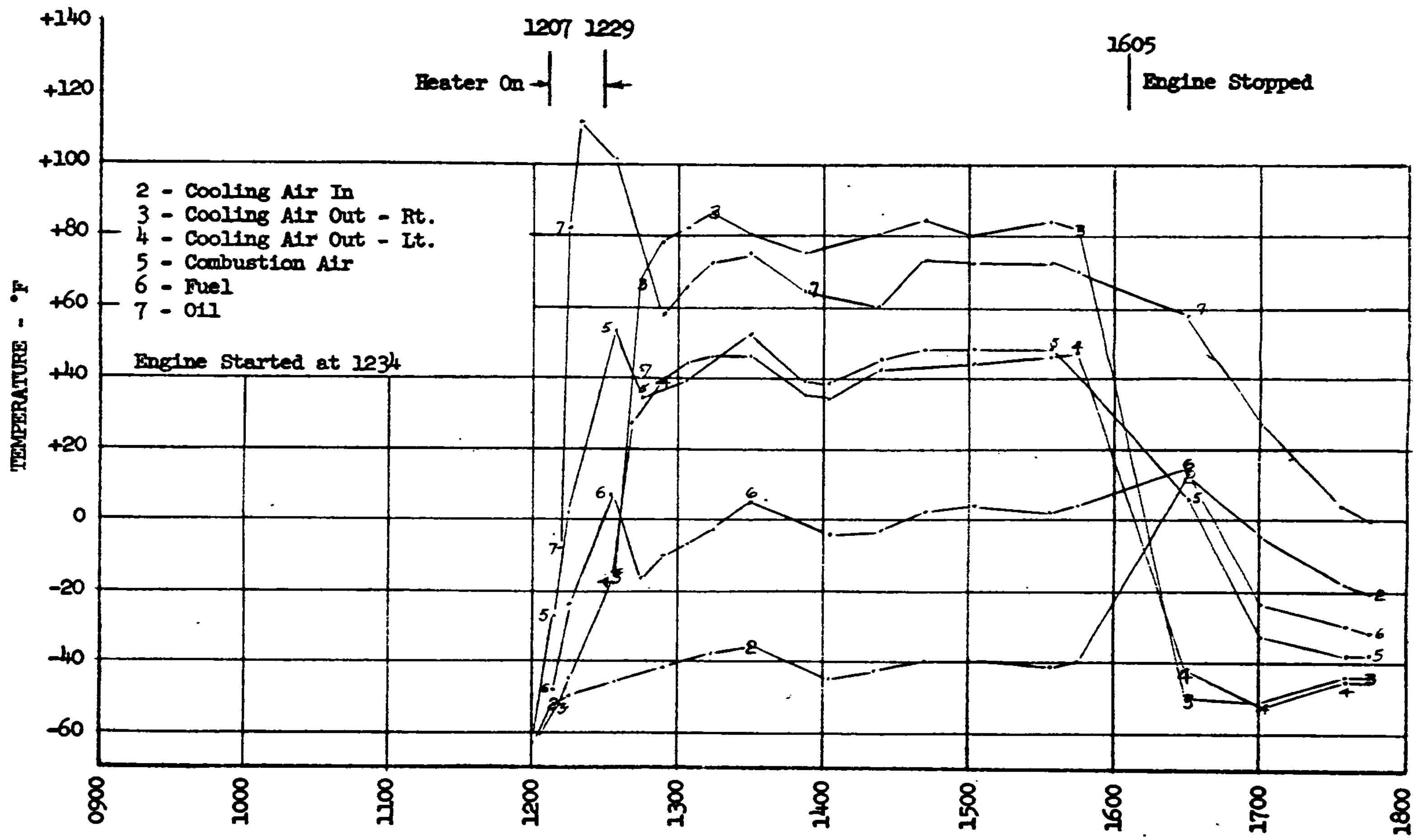

FIGURE 14: Engine-Generator Temperatures During Operation at -65°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

AIR CONDITIONER TEMPERATURES DURING HEATER OPERATION AT -65°F
DATE OF TEST: 9 August 1960

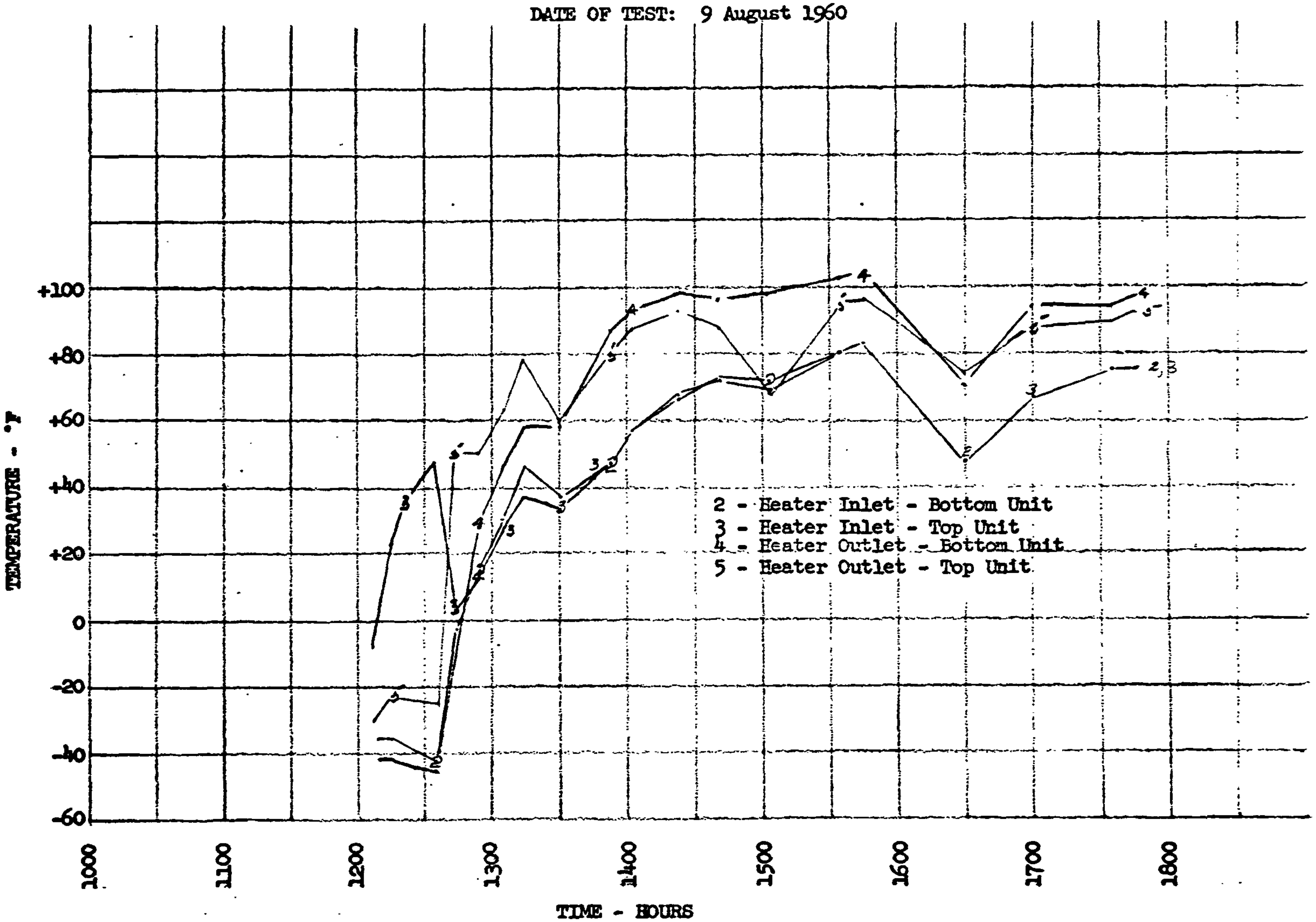

FIGURE 15: Personnel Compartment Heater Temperatures During Operation at -65°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

TEMPERATURES IN PERSONNEL COMPARTMENT DURING OPERATION AT -65°F

DATE OF TEST: 9 August 1960

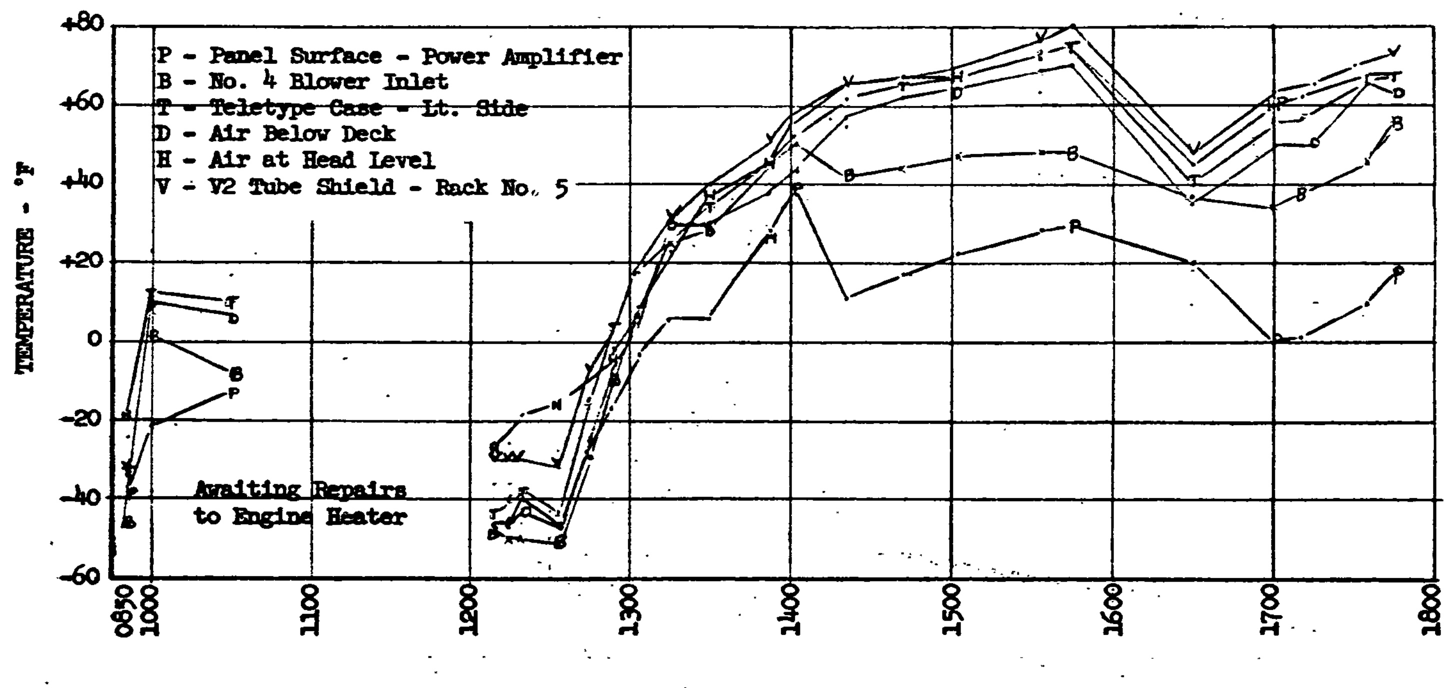

FIGURE 16: Personnel Compartment Temperatures During Operation at -65°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

COMMUNICATIONS EQUIPMENT TEMPERATURES DURING OPERATION AT -65°F

DATE OF TEST: 9 August 1960

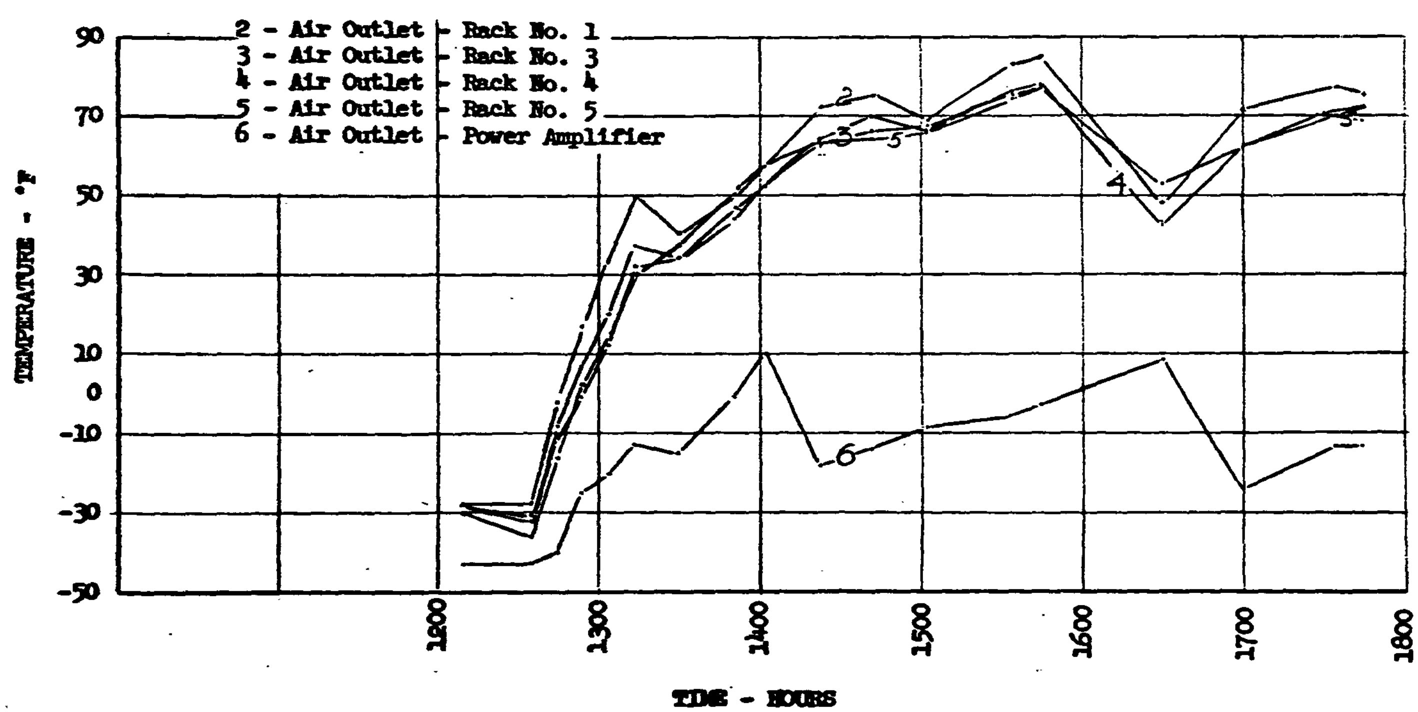

FIGURE 17: Communications Equipment Temperatures During Operation at -65°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

ANTENNA TEMPERATURES DURING HEATER OPERATION AT -65°F

DATE OF TEST: 9 August 1960

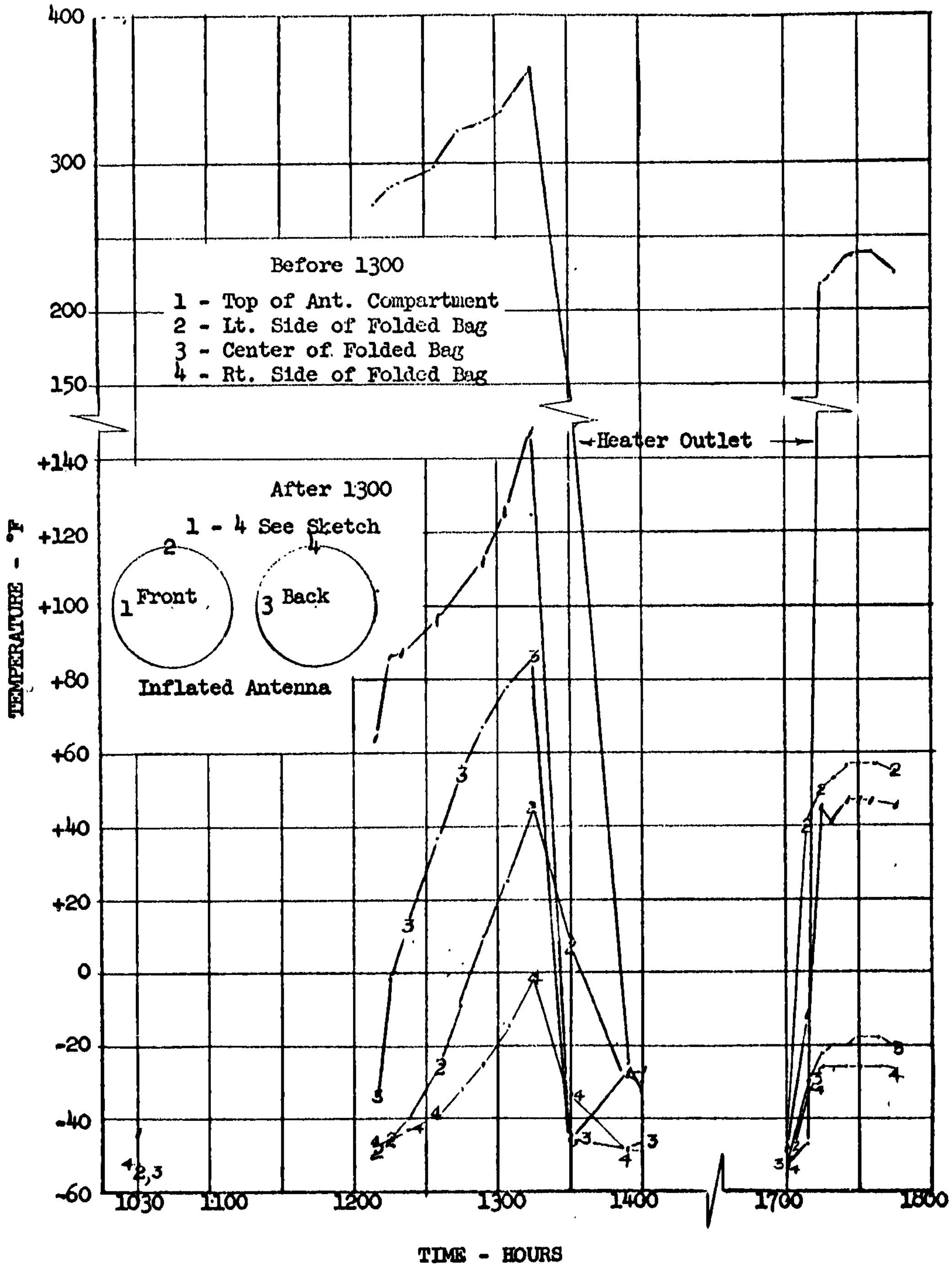

FIGURE 18: Antenna Temperatures During Operation at -65°F

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

AMBIENT CONDITIONS DURING DRYING PERIOD BEFORE HIGH HUMIDITY SOAK
DATES OF TEST: 14 and 15 August 1960

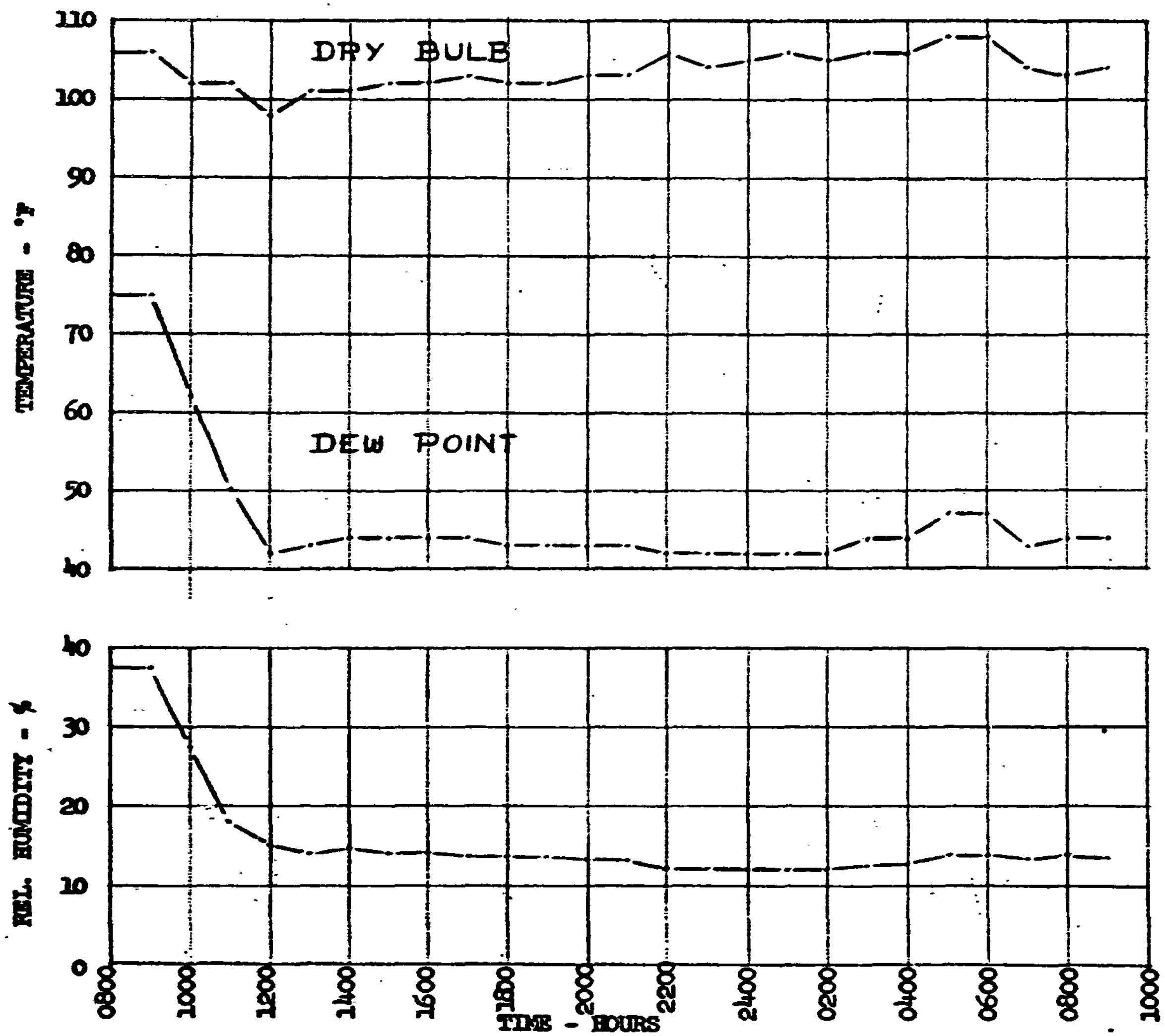

FIGURE 19: Ambient Conditions During Drying Period Prior to High Humidity Test

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

AMBIENT CONDITIONS DURING HIGH HUMIDITY SOAK
DATES OF TEST: 16 thru 20 August 1960

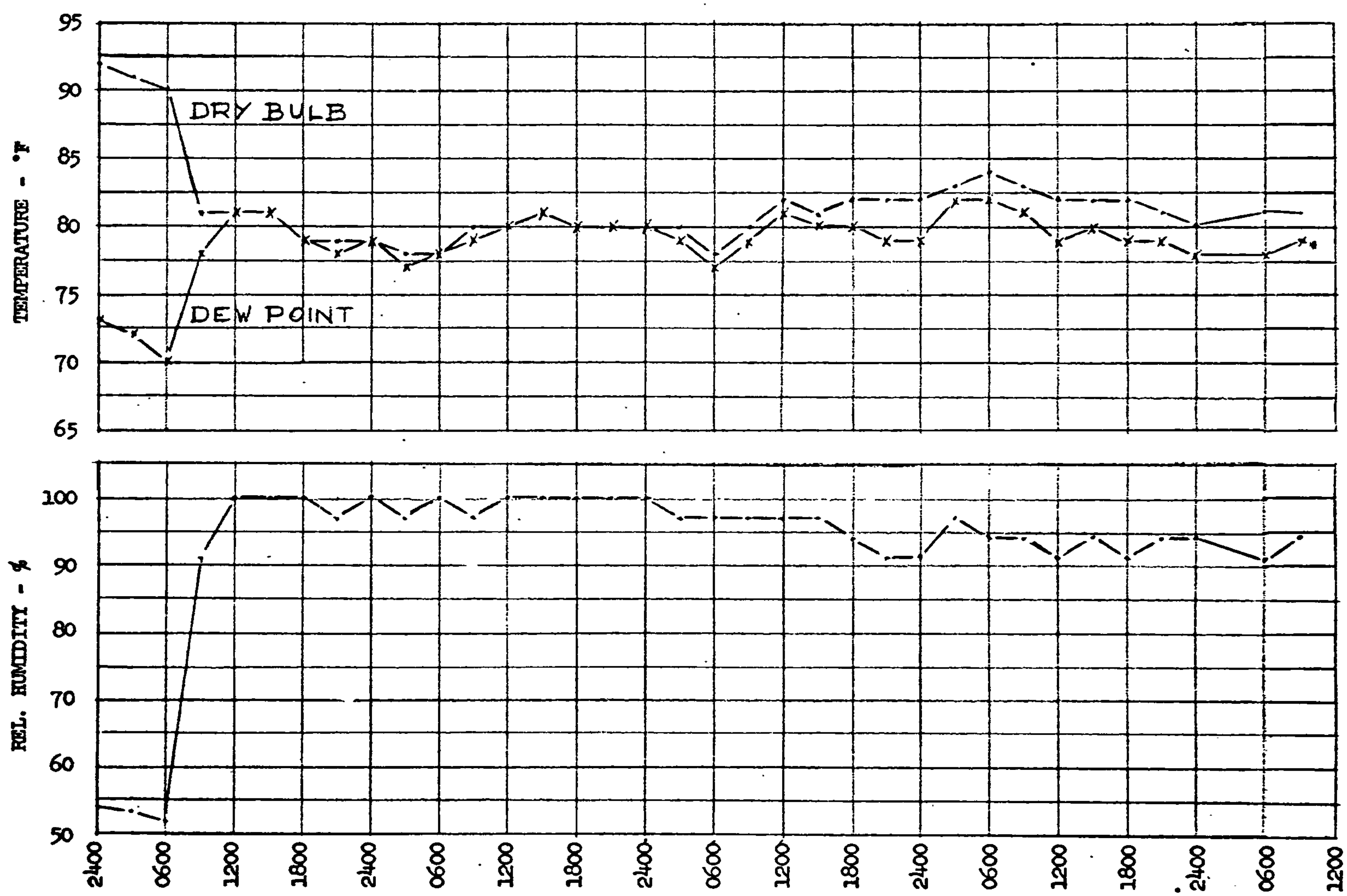

FIGURE 20: Ambient Conditions During High Humidity Soak

ENVIRONMENTAL TESTS OF PERSHING COMMUNICATION PACK, AN/TRC-80

AMBIENT CONDITIONS DURING OPERATION AT HIGH HUMIDITY

DATE OF TEST: 20 August 1960

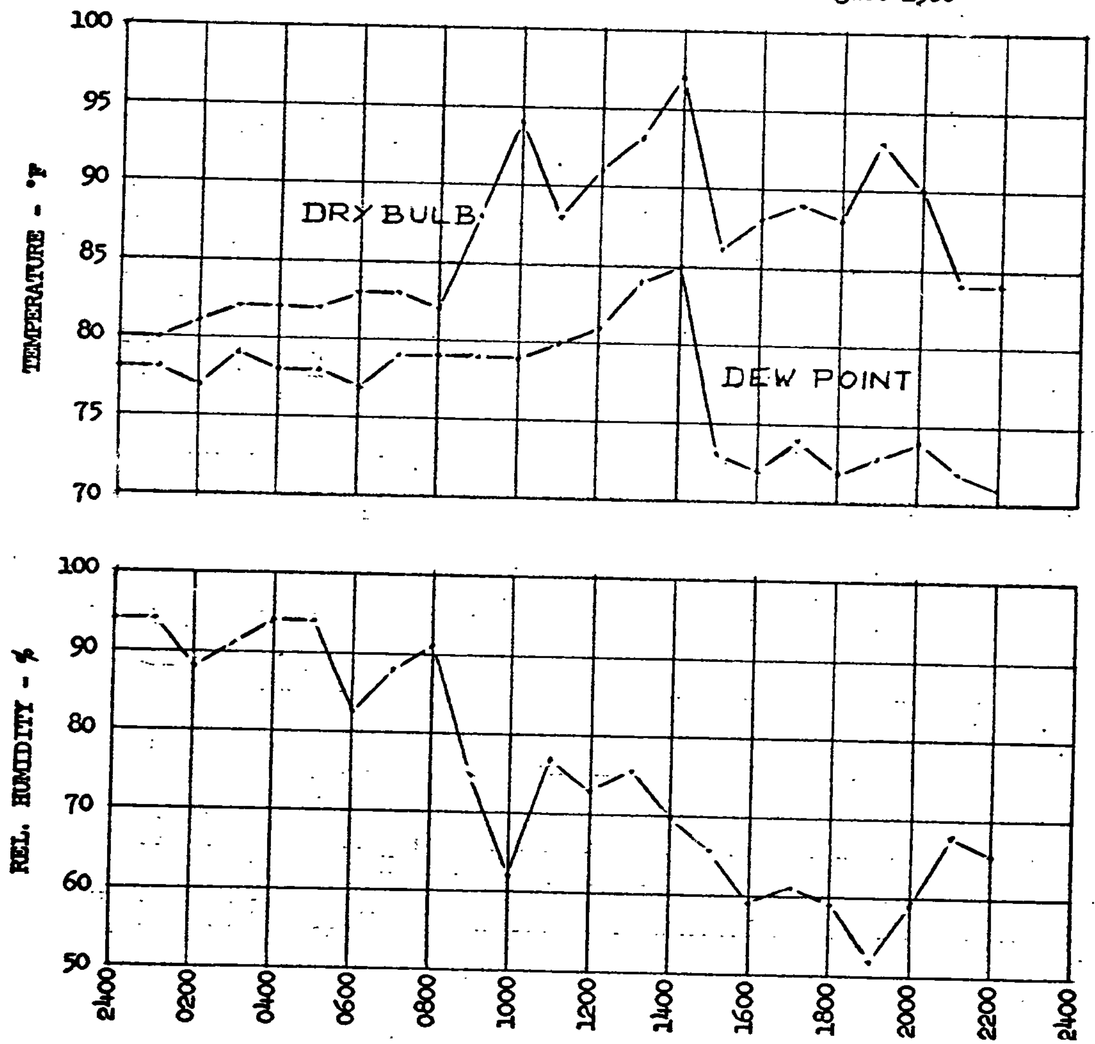

FIGURE 21: Ambient Conditions During Test Following High Humidity Soak

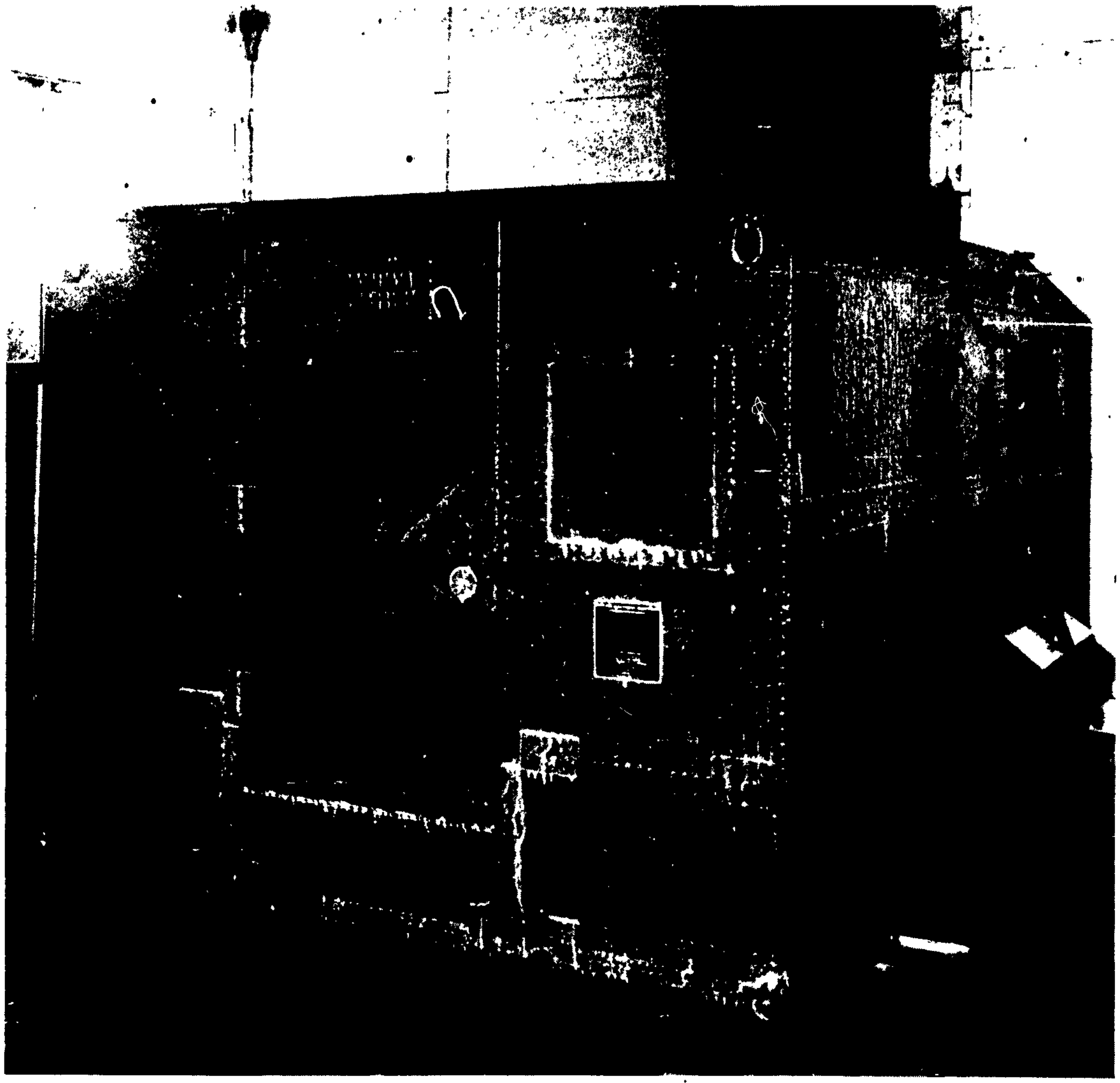

FIGURE 22: Communication Pack With 0.2 Inch Ice On Exterior Surfaces

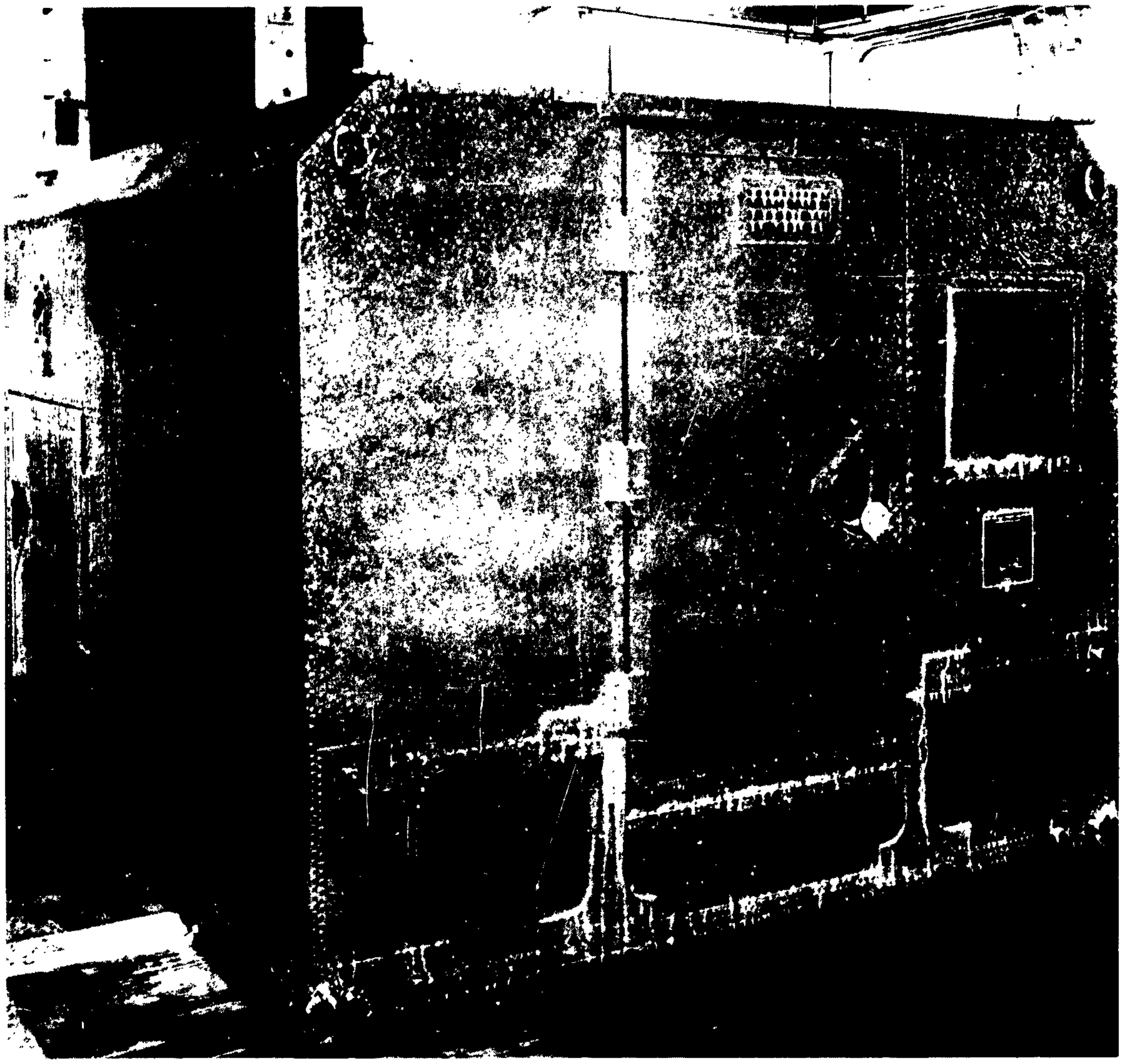

FIGURE 23: Communication Pack With 0.2 Inch Ice On Exterior Surfaces

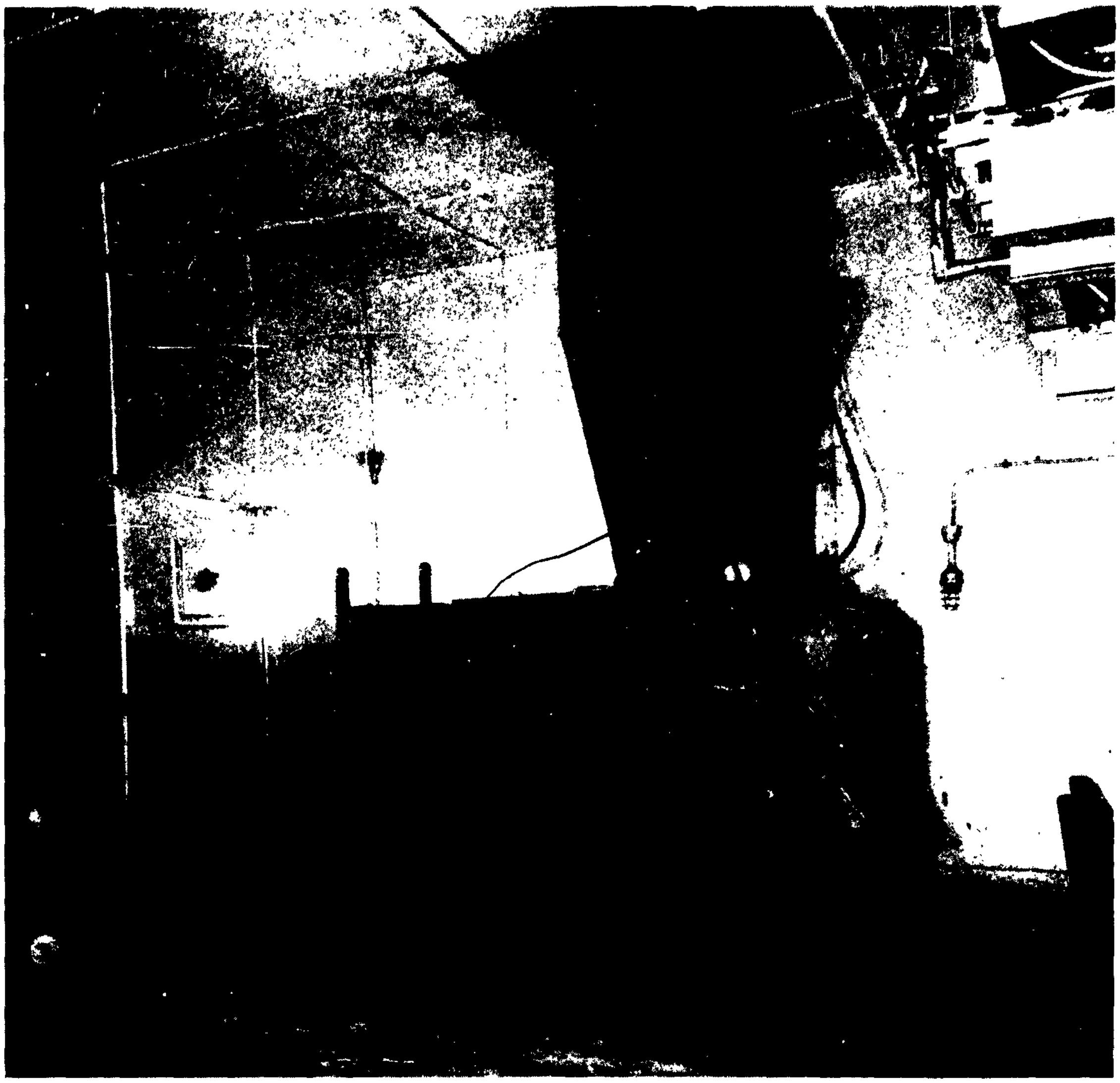

FIGURE 24: Antenna Elevated After First Phase of Icing Tests

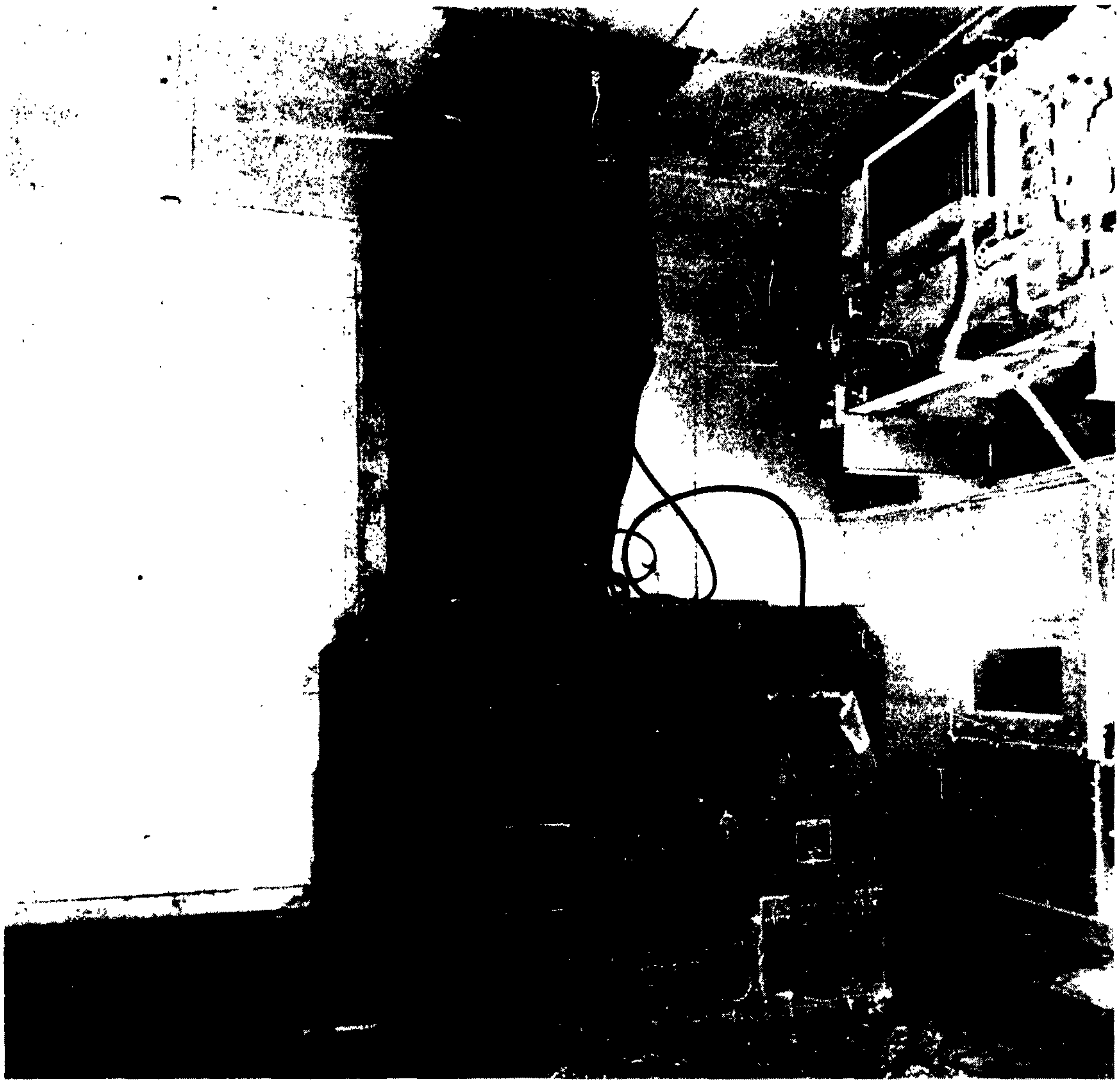

FIGURE 25: Ice Deposit on Antenna During Icing Test

FIGURE 26: Ice Deposit on Antenna During Icing Test

TABLE III

LOGBOOK

Date	Time	Temp.	Remarks
1 Aug.	0600	+125°F	Heat lamps turned on.
	0830		Heat lamps removed. Surface of hut checked.
	0855		Heat lamps replaced.
	0900		Heat lamps back on until 1020.
	0908		Engine started. Choke sticks.
	0912		All equipment on except PA beam.
	0931		PA beam on.
	1005		Equipment shut off because of excessive air temp. 130°F. Air conditioners and rack blowers were still on.
	1010		Both air conditioners cutting in and out.
	1020		Removed heat lamps. CO up to 0.035%.
	1038		Hut door opened temp. outside cooler than temp. inside.
	1030		Belvoir personnel was working on air conditioner.
	1125		Martin console quit. Circuit breaker kicks off.
	1130		Shut down because of high (140°F) temp. on inside.
	1135		Antenna erected w/o difficulty.
	1137		Everything turned off to allow work on air conditioner. Engine idling. Contemplate bypassing thermal cutout on A/C's.
	1447		Start mg. Left A/C working.
	1450		Fuse on purge fan blew. Fan left on by accident.
	1515		Both A/C's now working. Right unit working mounted on block outside shelter. Thermocouples on left unit have been disconnected since 1337.
	1540		Reconnected left A/C in and out thermocouples at evaporator.
	1540		Ran out of gas. Engine failed to start on internal tank. Trouble later found to be that fuel line from engine was connected to vent line instead of supply line.
	1600		Mg started with slave kit.
	1602		A/C on only. Also electronic gear.
	1818		Shut everything down. Raise room temp. to +160°F.
2 Aug.		+125°F	After 160°F Soak.
	0946		Start MG.
	0956		Equipment on.
	1117		Start bring room temp. to ambient.

TABLE III (CONT.)

Date	Time	Temp.	Remarks
2 Aug		+80°F	
	1510		Turn on equipment.
	1625		Shut down.
2 Aug			Post high temperature inspection revealed: a. Holes in antenna bag probably caused by sharp corners of blower housing. b. Outside roof of hut sagging 1/2 inch over operator's compartment.
3 Aug		Normal Ambient	
	0848		Equipment turned on.
	1030		HP-206A failed. (Test Instrument)
	1130		Borrowed HP-205AH from Fire Control.
	1230		Muffler on E-G burned out.
5 Aug	0850	-25°F	Applied heat lamp to frozen throttle motor.
	0900		Throttle motor thawed.
	0910		Battery thermocouple reading wrong.
	0922		No. 38 thermocouple used for battery temp.
	0952		Temp. checked.
	0955		Crank engine.
	0955		Engine started.
	1002		Engine up to speed.
	1003		Started A/C heater. Only top unit running.
	1003		PA blower on.
	1004		Lower heater on. Blower running but no heat.
	1005		Top heater stopped.
	1009		All rack blowers on.
	1010		Top heater only working.
	1015		Engine panel meter reads 210, PA meter reads 216.
	1018		Frost collecting on panel and meter.
	1030		PA beam turned on.
	1031		Electronic trouble.
	1100		Moved thermocouple previously located at top heater to left vent.
	1120		Trouble with cavity "J".
	1205		Continuing testing. Antenna erected with no other difficulty than those imposed by use of mittens.
	1600		Folded antenna - Very stiff. Ice and frost on all surfaces. All platform pins were open. Blamed on walking around with arctic boots.

TABLE III (CONT.)

Date	Time	Temp.	Remarks
			Room held at 0°F for Saturday and Sunday until 1500. Then it was pulled down to -65°F and soaked. A new heater float was installed on Saturday.
8 Aug.	0800 -	-65°F	Thermocouple check and awaiting engine people.
	0900		Started test with external power.
	1024		Heaters on.
	1025		Equipment blowers on.
	1030		Rack 1 on.
	1035		Racks 4 and 5 on.
	1042		Teletype does not work.
	1046		PA blower on.
	1105		Antenna heater off. Restarted.
	1109		Everything shut off while Belvoir paralleled other battery.
	1112		Antenna heater off.
	1117		Antenna heater started.
	1120		Antenna heater off.
	1126		Antenna heater on.
	1132		Antenna heater off.
	1133		Antenna heater developed severe leak.
	1150		Antenna heater removed from cold room to be checked.
	1214		Engine heater started.
	1238		Engine heater turned off.
	1243		Start engine crank.
	1243		Engine started.
	1355		Heaters and equipment turned on. Hand spinning required to get the heater fan going.
	1436		Antenna heater turned.
	1445		Beam on.
	1455		PA kicked off - test discontinued.

Malfunctions:

a. Terminal personnel door warped.

b. Terminal personnel compartment floor bulged in several places.

c. PA air intake filter continuously frosted up.

d. Teletype motor did not operate until temperature was raised.

TABLE III (CONT.)

Date	Time	Temp.	Remarks
9 Aug	0800	-65°F	Working on PA using external power.
	0900		Used heat lamp on top air conditioner to start.
	1002		+15°F at operator.
	1013		All equipment working.
	1025		Turned off for change over to engine generator.
	1050		Frozen fan prevents start of heater.
	1110		Used electric hot air blower on frozen fan.
	1207		Heater working (Engine). Heater working (Antenna).
	1229		Engine heater turned off.
	1229		Started cranking. Starter solenoid frozen. Had to be broken loose.
	1231		Engine started.
	1236		RF and heater (personnel) on.
	1320		Started antenna erection. Coldest temp. -2°F.
	1335		Antenna up and thermocouple installed.
	1338		Antenna heater connected to antenna compartment.
	1340		Antenna erection completed.
	1350		Frosted air intake knocked out PA.
	1355		Antenna compartment heater off. Some gasoline spilled on floor when frozen hose broke permitting fuel to siphon out on floor.
	1605		M-G quit.
	1625		External generator turned on.
	1705		Antenna heater on connected to antenna.
	1800		Antenna temperatures stabilized at -25°F but unit could not be lowered because outer torus was frozen solid. Broken zipper on antenna.
20 Aug		+80°F	No sign of damage from humidity.
	0905		Engine started w/o difficulty.
	0915		Air conditioner and other equipment all on except beam.
	0925		Dried floor with rags.
	0930		Beam on.
	1905		Engine generator cooling fan drive gear stripped teeth.

ABERDEEN PROVING GROUND, MARYLAND

AUTOMOTIVE ENGINEERING LABORATORY REPORT

PROJECT NO: .127X2/160

CS
DATE: 8 March 1961

REPORT NO: 61-16

ROAD SHOCK AND VIBRATION TEST OF THE COMMUNICATION PACK FOR THE PERSHING MISSILE SYSTEM

DATE OF TEST: 14 January 1961

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INCLOSURES

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3 Record Sections Nos. 61-16-69 thru 61-16-71
7 APG Photographs Nos. S18-001-146-1430-55-3T/ORD-61 thru S18-001-150-1430-55-7T/ORD-61; S18-001-161-1430-55-8T/ORD-61 and S18-001-186-1430-55-9T/ORD-61

1. INTRODUCTION

1.1 Objective

These tests were conducted to determine the road shock and vibration environment encountered by the Pershing Communication Package in its ground transportation mode.

2. RESULTS

2.1 Specific

2.1.1 Road Shock and Vibration

Maximum peak accelerations measured at critical speeds on the three (3) test courses are contained in the following table. The values were extracted from the Statistical Data Sheets.

MAXIMUM ZERO-TO-PEAK ACCELERATION - g

Transducer Location	Plane	Six-Inch Washboard 15 mph	Bituminous Concrete - 22 mph	Ramp 11 mph
Shelter Base	Vert.	2.1	1.7	10.0
	Trans.	1.5	1.1	6.8
	Long.	2.8	1.7	13.4
Air Conditioner - Outboard	Vert.	6.1	1.3	12.0
	Trans.	4.4	1.9	8.9
	Long.	3.1	1.1	15.0
Instrument Racks Nos. 4 & 5	Vert.	5.6	5.1	-
	Trans.	7.2	1.2	4.5
	Long.	3.4	4.2	13.0
Klystron Coax Line	Vert.	6.6	1.2	10.0
	Trans.	3.6	1.6	8.0
	Long.	7.3	2.1	14.0
Instrument Racks Nos. 2 & 3	Vert.	3.6	1.7	7.0
	Trans.	2.4	1.2	6.1
	Long.	2.5	2.2	16.0
Teletype Table	Vert.	4.1	1.7	8.6
Engine Generator	Vert.	2.7	0.3	9.5
	Long.	1.5	0.3	7.1

Note: - Channel not working, no data obtained.

Statistical analysis for each channel measured on each course are contained in Inclosures 61-16-3 thru 61-16-29. Spectograms (X-Y Plots) of average acceleration vs the frequency spectrum for each channel measured on the Six-Inch Washboard and level Paved Courses are included as Inclosures 61-16-30 thru 61-16-68. Oscillographic record sections showing the time-history of typical shock pulses for each data channel on the Ramp Course are included as Inclosures 61-16-69 thru 61-16-71.

2.1.2 Operation Checks and Visual Inspections

Contractor conducted operational and visual checks made before and after each test revealed the following discrepancies:

a. Red line operation caused by low "module" outputs were noted at the following positions.

Synthesizer #2, Mixer #1
Synthesizer #2, Mixer #2
Synthesizer #3, Mixer #2
All Synthesizers, Multiplier #3

b. Receiver #1, regulator power supply required several tube replacements.

c. Power amplifier:

(1) Canvas air duct separated from klystron.

(2) Output transmission line was displaced from vertical alignment.

(3) 90° R.F. connector on input attenuator loosened.

d. Antenna Compartment - all locks released with the following results:

(1) Pulleys broken and support brackets sprung (see APG Photograph No. S18-001-186-1430-55-9T/ORD 61).

(2) Antenna drive cable jumped guides.

(3) Lead screw bent and binding.

(4) Air interlock was intermittent.

Note: Antenna could be raised and lowered with external assistance.

e. Receivers #1 and #2 - several wires were broken at the terminal point of the multimeter selector switch in each receiver unit. (See APG Photograph No. S18-001-161-1430-55-8T/ORD 61.)

f. Martin Console - Army range radio selector button would not hold, had to be held manually to ring and talk. No receiver audio could be obtained from console.

g. Teletypewriter - Paper spool brake released and caused unit to jam.

h. Engine-generator:

(1) Vent from winterization heater broken.

(2) All 4 shock mounts appeared close to fatigue failure with some permanent set in the shock absorbing material.

i. Instrument Rack Blowers - one shock mount on receiver rack blower and one on exciter rack blower ruptured.

j. Miscellaneous Hardware:

(1) Lenses in overhead lights fell out.

(2) Pilot light cover came off.

(3) Hinge pins, one section of rack #5 came out.

(4) Screws and nuts loosened.

2.2 Discussion

2.2.1 Road Shock and Vibration

Continuous vibration is generated by the interaction of track blocks, road surfaces and various suspension components. From a vibration standpoint the most severe environment existed during operation on hard surfaced roads. The statistical analysis indicates the accelerations recorded on the Six-Inch Washboard Course at 15 mph are greater than those recorded on the level Paved Course at 22 mph. However, the magnitude of the fundamental frequency (caused by track engagement) for hard surfaced operation was greater on the Paved Course at 22 mph where a resonant condition was encountered. Most other discrete peaks in the spectrum are harmonics. The fundamental frequency may be expressed as:

$$f_1 = \frac{cs}{p} \quad \text{where} \quad \begin{aligned} s &= \text{road speed in mph} \\ c &= 1.47 \text{ (velocity in ft/sec/mph)} \\ p &= .5 \text{ ft. (track pitch, 6 in.)} \end{aligned}$$

Spectral analysis of the Ramp Course data were not included as inclosures because non-repetative shock pulses do not lend themselves to spectral analysis by the analyzing system used. Since the characteristics of the shock pulse appears more meaningful in describing the Ramp Course environment, oscillographic record sections showing typical shock pulse excitations and are included as Inclosures 61-16-69 thru 61-16-71.

2.2.2 Operational Checks and Visual Inspections

Operational and visual checks were performed by contractor personnel prior to and at conclusion of each test to determine if all components were in proper operating condition. It should be noted however, that the TH-5 unit was inoperate prior to testing and a complete electronic checkout was not obtained. After tests were completed a new TH-5 unit was received and substituted for the defective unit. Satisfactory transmission and reception of both teletype and voice signals could then be obtained without correction of the deficiencies in Paragraph 2.1.2.

While the communication package could be operated after the test it should be noted that the number of deficiencies listed indicates a need for attentuation of shock and vibration inputs to the mounted equipment. From a durability standpoint the failure rate of the mounted equipment was high for the limited mileage (25 miles) accumulated during these tests. Durability characteristics of the vehicle could not be evaluated in this report because of the limited test mileage. Modifications to the communication pack should be made and the unit and vehicle be subjected to transportation endurance tests comparable to the severity of its life expectancy to determine its durability and reliability characteristics.

2.2.3 Critical Speeds

Only data obtained at critical speeds and on courses exciting significant shock and vibration environments were reduced and included in this report. Critical speeds for any test course are defined as, 1) the speed at which the test item is at maximum response, 2) the most severe environment the vehicle driver can tolerate, 3) a speed just below that at which failure of the vehicle suspension or the on-board equipment is imminent, or 4) the maximum safe road speed with respect to vehicle stability. Critical speeds for this test, and the limiting factors are tabulated as follows:

Course	Speed	Limiting Factor
Six-Inch Washboard	15	Appeared to be speed of maximum vehicle response to the test course profile.
Paved (Bituminous Concrete)	22	Not limited - vehicle and on-board gear at maximum response.
Ramp Course	11	Maximum safe speed - driver lost control of vehicle during impact on bumps at higher speed.

3. DETAILS OF TEST

3.1 Description of Material

The Pershing Communication Package (AN/TRC-80 Communication Terminal) is a self contained unit capable of duplex "transmission and reception" of one voice and one teletype circuit. 208/120 volt, 3 phase, 400 cps power can be supplied by an intergral gasoline engine-generator or from the "system" primary power package. The inflatable antenna is of parabolic type, eight (8) feet in diameter and formed of two (2) plastic fabric sections. Inflation is achieved by an induction motor-driven centrifugal blower. The PCP weighs 4100 pounds and is transported in conjunction with a tool and spare parts package on the XM474E1 Universal Carrier. For this test the weight of the spare parts package was simulated by a rectangular sheet of armor plate.

The XM474E1 Universal Carrier is a track laying vehicle whose hull is designed for transportation of cargo. The gross weight of the XM474E1 as tested was 16,890 pounds.

3.2 Procedure

On each course, test operation was started at a low vehicle speed and gradually increased to determine the critical speed on each course. Visual inspections and operational checks of the PCP were conducted prior to and after each test phase by the manufactures representatives.

3.3 Test Courses

The test courses and the road speeds at which data were recorded were as follows:

a. Six-Inch Washboard - 7, 9 and 15 mph.

b. Bituminous Concrete (Paved) - 8 to 36 mph in 2 mph increments.

c. Ramp Course - 5 to 11 mph in 1 mph increments.

d. Braking (on Paved) - 5, 10, 15 and 20 mph.

Data were compiled for the most severe conditions only. Examination of the emergency braking test indicated that acceleration values during brake application were less than values measured during paved operation. Brake test data were not reduced. Profiles of the Six-Inch Washboard, Paved and Special Ramp Courses are shown on Sketches 61-16-1 and 61-16-2.

3.4 Instrumentation

The instrumentation used in these tests was as follows:

a. Transducers: Statham Laboratories, Unbonded Strain Gage Accelerometers, Model A5; $\pm 15g$, $f_n = 300$ cps and $\pm 25g$, $f_n = 400$ cps.

b. Recording Equipment: The outputs from all transducers were recorded on a Consolidated Electrodynamics Corp., Model 5-701 Magnetic Tape Recorder installed in an instrument vehicle which, operating on smooth surfaces alongside the courses, paced the test vehicle as it traveled over the test courses. The transducers were coupled to the recorder using cables approximately 100 feet long. In addition to the Model 5-701 Recorder, the system contained Consolidated Electrodynamics Corp., Model 15-102 CM/FM Modulators and Consolidated Electrodynamics Corp., Model 1-129 Record Amplifiers.

c. Data-Reduction Equipment and Procedures: Data recorded in the field on the magnetic tape were transcribed onto magnetic tape loops. This process required the following Consolidated Electrodynamics Equipment: Model 5-752 Reel Transport; Model 15-103 CM Demodulators; Model 1-142 Record Amplifiers; and the Model 5-781 Loop Transport. After the loops were made they were analyzed using the loop transport, Model 1-143A Reproduce Amplifiers and the Technical Products Company Model TP-625 Waveform Analyzing System.

The analyzing system is capable of presenting data in a variety of forms. The form chosen for presentation herein was average acceleration in g vs the frequency spectrum. For the analysis of data on the level Paved Course a 10 cps bandwidth filter was selected and the tape play-back speed was increased by the ratio 4:1 to give the analyzer an effective filter bandwidth of 2.5 cps. For analysis of data on the Six-Inch Washboard Course, where response at low frequency is present, two analysis sweeps were made as follows: 1) frequencies from 1.3 to 5 cps were analyzed at a tape play-back speed ratio of 16:1 to give an effective filter bandwidth of .625 cps, 2) frequencies from 5 cps up were analyzed using the effective 2.5 cps filter bandwidth described above. The sweep time used allowed the filter to scan the complete loop before it moved through its own bandwidth. A 0.1 second time constant was used in averaging the acceleration. The signal output from the analyzer was recorded on a Moseley, Model 5-8, X-Y Plotter.

A pulse-height analyzer was also used in the analysis of data. This instrument is used to obtain a statistical indication of the number of times the amplitude of the output from a transducer exceeds any given magnitude level. It consists of ten counter banks, each bank is sensitive to a different magnitude level. Each successive lower level is a 10% of the top level less than the level above it. The 9 level is 90% of the 10 level and 8 level is 80% of the 10 level, 7 level is 70% of the 10 level, etc. Operationally, each level will count each time the input signal voltage (magnitude of transducer output) exceeds that level, but the counter will not reset itself to count again until the input signal drops below that particular level. Consequently, the lowest level may not always display the largest number of counts. This statistical counter responds to signals occurring within the frequency range 2 to 600 cps.

Photographs of the accelerometer installations described in Paragraph 3.4, Instrumentation, are included on APG Photographs S18-001-146-1430-55-3T/ORD-61 thru S18-001-150-1430-55-7T/ORD-61.

Before the test, accelerometers were calibrated in the laboratory on a shaker table. Before operation on each test course, a field calibration of the entire recording system was made by introducing known resistances into the accelerometer circuit.

4. CONCLUSION

The numerous electrical and mechanical deficiencies encountered during the limited mileage accumulated make this equipment unsatisfactory from a durability or reliability standpoint.

5. RECOMMENDATION

A redesigned version of the communication pack should be subjected to transportation endurance tests of severity commensurate with the life expectancy of the unit to determine its durability and reliability.

SUBMITTED:

G. C. Hiob

G. C. HIOB
Engineer

REVIEWED:

H. T. CLINE
Acting Chief, Dynamic Test Section

APPROVED:

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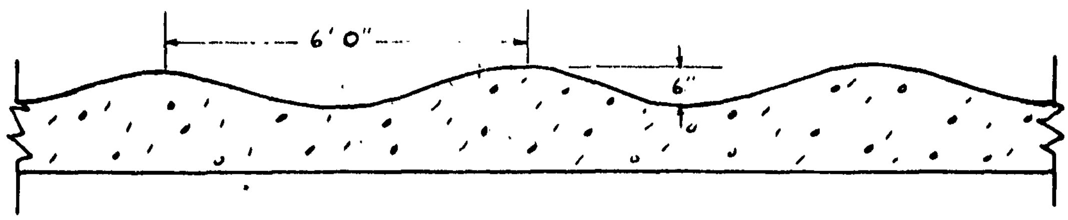
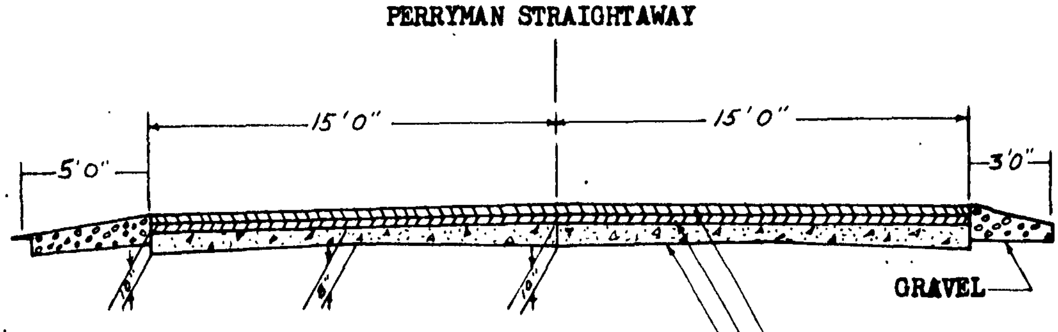
SIX-INCH WASHBOARD COURSE



The profile approaches a sine wave with a double amplitude of six inches and a complete cycle occurring every six feet for a distance of 800 feet. The course surface is concrete.

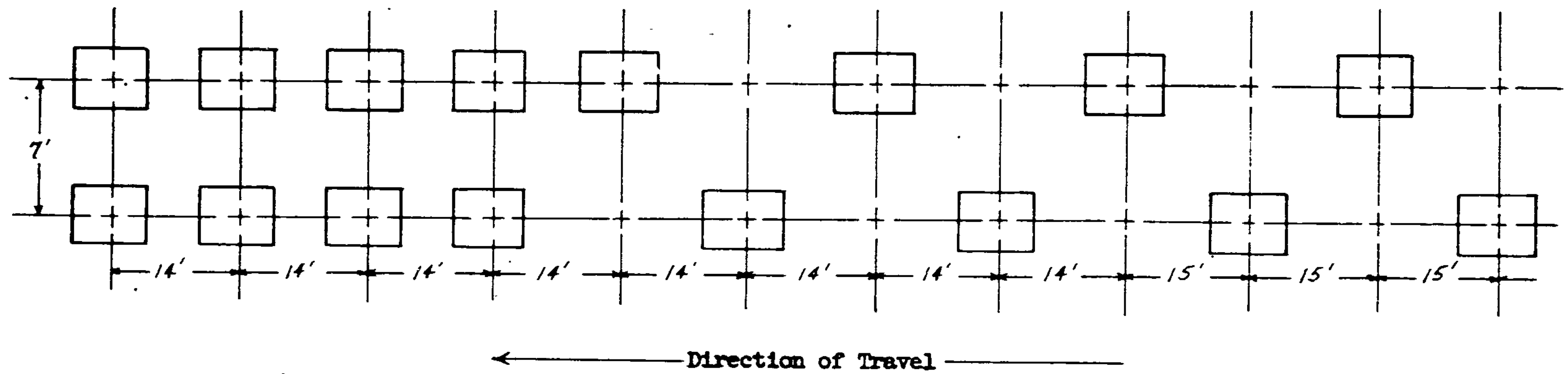
PERRYMAN STRAIGHTAWAY

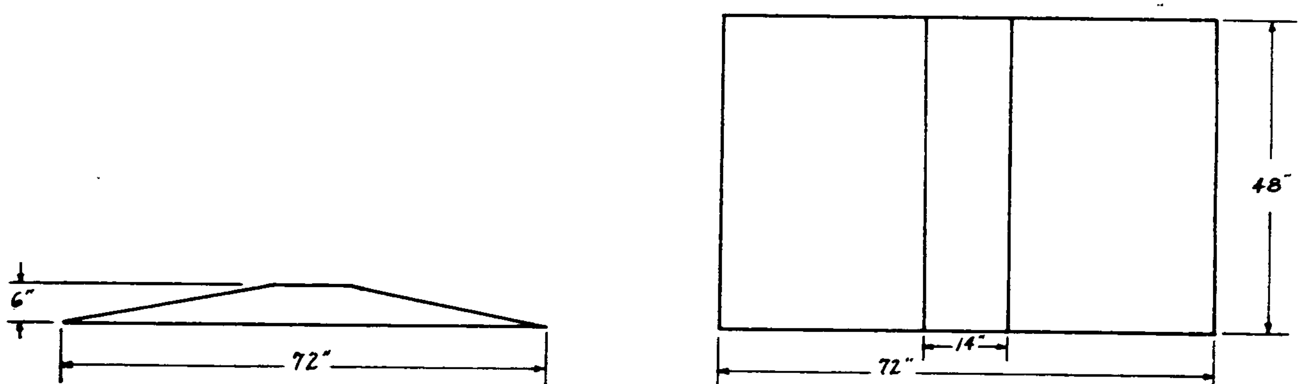


The paved straightaway is essentially a level road, three miles in length, with banked turn-around loops at each end. This course is used where high speed as well as tests requiring long periods of uninterrupted operation are desired.

DIAGRAM OF SPACING FOR RAMP COURSE

(Ramps Placed on Bituminous Concrete Surface)





Ramp Dimensions

STATISTICAL DATA

VEHICLE: XM474 w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASHBOARD TIRE PRESSURE ______ PSI

DATA CHANNEL: 1 PLANE: VERT

LOCATION: SHELTER BASE

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	2629	2201
20	2009	1990
30	1292	1263
40	658	666
50	288	282
60	92	104
70	29	43
80	4	7
90	0	3
100 = 2.1g	0	0

DATA CHANNEL: 2 PLANE: TRANS

LOCATION SHELTER BASE

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1847	1787
20	1165	1172
30	585	561
40	233	234
50	82	82
60	31	25
70	10	6
80	3	2
90	1	0
100 = 1.5g	0	0

NOTE: Plus and Minus denote polarity of accelerometer but accelerometers were not necessarily oriented on test item with respect to plus being up, right or forward.

STATISTICAL DATA

VEHICLE: XM474 -- w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASHBOARD TIRE PRESSURE ____ PSI

DATA CHANNEL: 3 PLANE: LONG

LOCATION: SHELTER BASE

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	2998	3000
20	1628	1620
30	676	675
40	212	229
50	52	58
60	12	10
70	2	0
80	1	0
90	1	0
100 = 2.8g	0	0

DATA CHANNEL: 4 PLANE: VERT.

LOCATION OUTBOARD AIR CONDITIONER

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1101	1124
20.	557	665
30	224	293
40	111	127
50	63	49
60	37	14
70	19	4
80	8	1
90	2	1
100 = 6.1g	0	0

STATISTICAL DATA

VEHICLE: XM474 w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASHBOARD TIRE PRESSURE ______ PSI

DATA CHANNEL: 5 PLANE: TRANS.

LOCATION: Outboard Air Conditioner

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1164	1117
20	534	597
30	387	408
40	298	292
50	209	219
60	120	161
70	34	100
80	5	35
90	0	4
100 = 4.4g	0	0

DATA CHANNEL: 6 PLANE: LONG

LOCATION Outboard Air Conditioner

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1350	1326
20	912	890
30	493	492
40	228	238
50	98	91
60	35	32
70	8	9
80	2	6
90	0	2
100 = 3.1g	0	0

ORDBG Form 8130-(0), 11 Jan 61 61-16-5

STATISTICAL DATA

VEHICLE: XM474 -- W/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: SIX - INCH WASHBOARD TIRE PRESSURE ________ PSI

DATA CHANNEL: 7 PLANE: VERT.

LOCATION: INSTRUMENT RACKS #4 & #5

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1279	1376
20	915	1123
30	596	853
40	343	617
50	165	407
60	65	18
70	21	1
80	9	0
90	2	0
100 = 5.6g	0	0

DATA CHANNEL: 8 PLANE: TRANS.

LOCATION INSTRUMENT RACKS #4 & #5

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1505	1402
20	1122	1080
30	643	690
40	296	392
50	110	177
60	35	93
70	11	36
80	1	12
90	0	1
100 = 7.2g	0	0

ORDBG Form 8130-(0), 11 Jan 61

61-16-6

STATISTICAL DATA

VEHICLE: XM474 -- w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASH BOARD TIRE PRESSURE ______ PSI

DATA CHANNEL: 9 PLANE: LONG

LOCATION: INSTRUMENT RACKS #4 & #5

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1462	1445
20	877	911
30	438	488
40	187	244
50	60	92
60	12	30
70	2	16
80	0	4
90	0	2
100 = 3.4g	0	0

DATA CHANNEL: 10 PLANE: VERT.

LOCATION KLYSTRON COAX

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1210	1329
20	629	594
30	288	226
40	146	93
50	87	49
60	56	22
70	33	12
80	18	3
90	3	0
100 = 6.6g	0	0

ORDBG Form 8130-(O), 11 Jan 61 61-16-7

STATISTICAL DATA

VEHICLE: XM474 w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASH BOARD TIRE PRESSURE ______ PSI

DATA CHANNEL: 11 PLANE: TRANS.

LOCATION: KLYSTRON COAX

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1626	1622
20	1124	1143
30	729	682
40	500	416
50	368	287
60	259	183
70	161	84
80	50	9
90	5	0
100 = 3.6g	0	0

DATA CHANNEL: 12 PLANE: LONG.

LOCATION KLYSTRON COAX

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	915	861
20	587	532
30	360	237
40	263	96
50	220	24
60	185	0
70	137	0
80	64	0
90	7	0
100 = 7.3g	0	0

STATISTICAL DATA

VEHICLE: XM474 -- W/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASHBOARD TIRE PRESSURE ______ PSI

DATA CHANNEL: 13 PLANE: VERT.

LOCATION: INSTRUMENT RACKS #2 & #3

ROAD SPEED: 15 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	848	810
20	663	648
30	464	401
40	288	230
50	157	133
60	85	60
70	41	27
80	14	13
90	4	3
100 = 3.6g	0	0

DATA CHANNEL: 14 PLANE: TRANS.

LOCATION INSTRUMENT RACKS #2 & #3

ROAD SPEED 15 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	914	853
20	643	616
30	393	422
40	167	198
50	58	72
60	18	35
70	7	12
80	4	5
90	0	1
100 = 2.4g	0	0

ORDBG Form 8130-(0), 11 Jan 61

61-16-9

STATISTICAL DATA

VEHICLE: XM474 -- w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: SIX-INCH WASHBOARD TIRE PRESSURE ____________ PSI

DATA CHANNEL: 15 PLANE: LONG	DATA CHANNEL: 16 PLANE: VERT.
LOCATION: INSTRUMENT RACKS #2 & #3	LOCATION TELETYPE TABLE
ROAD SPEED: 15 MPH	ROAD SPEED 15 MPH
LENGTH OF RECORD: 20.1 SECONDS	LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	No. of Times Level was Exceeded Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	No. of Times Level was Exceeded Minus
10	1364	1332	10	1219	1092
20	937	902	20	916	831
30	565	507	30	590	524
40	206	214	40	327	291
50	63	84	50	147	143
60	21	25	60	69	52
70	5	9	70	22	17
80	0	4	80	5	3
90	0	1	90	1	0
100 = 2.5g	0	0	100 = 4.1g	0	0

ORDBG Form 8130-(0), 11 Jan 61 61-16-10

STATISTICAL DATA

VEHICLE: XM474 -- w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: SIX - INCH WASHBOARD TIRE PRESSURE ______ PSI

DATA CHANNEL: 17 PLANE: VERT.	DATA CHANNEL: 18 PLANE: LONG
LOCATION: ENGINE GENERATOR	LOCATION ENGINE GENERATOR
ROAD SPEED: 15 MPH	ROAD SPEED 15 MPH
LENGTH OF RECORD: 20.1 SECONDS	LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	242	194	10	303	210
20	162	153	20	235	163
30	91	129	30	189	122
40	9	118	40	96	83
50	5	67	50	44	36
60	3	29	60	23	11
70	1	15	70	6	3
80	0	6	80	2	1
90	0	2	90	1	0
100 = 2.7g	0	0	100 = 1.5g	0	0

STATISTICAL DATA

VEHICLE: XM474 w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE _______ PSI

DATA CHANNEL: 1 PLANE: VERT.	DATA CHANNEL: 2 PLANE: TRANS.
LOCATION: SHELTER BASE	LOCATION SHELTER BASE
ROAD SPEED: 22 MPH	ROAD SPEED 22 MPH
LENGTH OF RECORD: 20.1 SECONDS	LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	3685	3932	10	1943	1743
20	2242	2398	20	1825	1540
30	1138	1125	30	1464	1255
40	510	435	40	949	943
50	228	165	50	438	556
60	67	51	60	260	262
70	26	10	70	40	22
80	7	1	80	7	10
90	2	0	90	1	4
100 = 1.7g	0	0	100 = 1.1g	0	0

NOTE: Plus and Minus denote polarity of accelerometer but accelerometers were not necessarily oriented on test item with respect to plus being up, right or forward.

STATISTICAL DATA

VEHICLE: XM474 w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ______ PSI

DATA CHANNEL: 3 PLANE: LONG.

LOCATION: SHELTER BASE

ROAD SPEED: 22 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	4245	4115
20	3411	3379
30	2156	2261
40	935	1013
50	319	377
60	95	149
70	19	48
80	5	16
90	2	1
100 = 1.7g	0	0

DATA CHANNEL: 4 PLANE: VERT.

LOCATION OUTBOARD AIR CONDITIONER

ROAD SPEED 22 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1574	1593
20	1406	1450
30	1143	1165
40	767	802
50	400	451
60	170	212
70	44	72
80	7	16
90	1	0
100 = 1.3g	0	0

STATISTICAL DATA

VEHICLE: XM474 -- w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ______ PSI

DATA CHANNEL: 5	PLANE: TRANS.			DATA CHANNEL: 6	PLANE: LONG.		
LOCATION: Outboard Air Conditioner				LOCATION Outboard Air Conditioner			
ROAD SPEED: 22 MPH				ROAD SPEED 22 MPH			
LENGTH OF RECORD: 20.1 SECONDS				LENGTH OF RECORD 20.1 SECONDS			
Amplitude Level - %		No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %		No. of Times Level was Exceeded Plus	Minus
10		1313	1309	10		1365	1399
20		1283	1269	20		1308	1356
30		1196	1166	30		1189	1194
40		1051	1011	40		1001	853
50		838	822	50		683	464
60		553	490	60		374	191
70		196	91	70		120	50
80		8	1	80		44	6
90		1	0	90		7	1
100 =	1.9g	0	0	100 =	1.1g	0	0

ORDBG Form 8130-(O), 11 Jan 61

61-16-14

STATISTICAL DATA

VEHICLE: XM474 W/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ______ PSI

DATA CHANNEL: 7 PLANE: VERT.
LOCATION: INSTRUMENT RACKS #4&#5
ROAD SPEED: 22 MPH
LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1470	1532
20	1444	1495
30	1431	1476
40	1371	1417
50	1061	1166
60	566	559
70	220	116
80	35	9
90	3	0
100 = 5.1g	0	0

DATA CHANNEL: 8 PLANE: TRANS.
LOCATION INSTRUMENT RACKS #4&#5
ROAD SPEED 22 MPH
LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1995	1823
20	1612	1574
30	1113	1273
40	732	862
50	416	437
60	130	168
70	32	50
80	2	11
90	0	2
100 = 1.2g	0	0

ORDBG Form 8130-(0), 11 Jan 61 61-16-15

STATISTICAL DATA

VEHICLE: XM474 .. w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ________ PSI

DATA CHANNEL: 9 PLANE: LONG.	DATA CHANNEL: 10 PLANE: VERT.
LOCATION: Instrument Racks #4 & #5	LOCATION Klystron Coax
ROAD SPEED: 22 MPH	ROAD SPEED 22 MPH
LENGTH OF RECORD: 20.1 SECONDS	LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1632	1912	10	2083	1982
20	1748	1821	20	1464	1405
30	1871	1656	30	864	901
40	1313	1400	40	406	491
50	493	1064	50	135	244
60	103	571	60	29	97
70	10	122	70	7	34
80	0	18	80	1	9
90	0	2	90	1	0
100 = 4.2g	0	0	100 = 1.2g	0	0

STATISTICAL DATA

VEHICLE: XM474 w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ______ PSI

DATA CHANNEL: 11 PLANE: TRANS.

LOCATION: KLYSTRON COAX

ROAD SPEED: 22 MPH

LENGTH OF RECORD: 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	2244	2254
20	1584	1608
30	923	893
40	413	411
50	172	145
60	72	31
70	20	8
80	4	0
90	2	0
100 = 1.6g	0	0

DATA CHANNEL: 12 PLANE: LONG

LOCATION KLYSTRON COAX

ROAD SPEED 22 MPH

LENGTH OF RECORD 20.1 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1254	1247
20	1133	1133
30	968	949
40	750	762
50	496	491
60	259	260
70	104	104
80	26	36
90	0	7
100 = 2.1g	0	0

ORDBG Form 8130-(0), 11 Jan 61

61-16-17

STATISTICAL DATA

VEHICLE: XM474 W/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ______ PSI

DATA CHANNEL: 13 PLANE: VERT.

LOCATION: INSTRUMENT RACKS #2 & #3

ROAD SPEED: 22 MPH

LENGTH OF RECORD: 20.0 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1649	1903
20	1604	1944
30	1522	1726
40	1173	1132
50	743	575
60	369	221
70	140	58
80	17	5
90	3	0
100 = 1.7g	0	0

DATA CHANNEL: 14 PLANE: TRANS.

LOCATION INSTRUMENT RACKS #2 & #3

ROAD SPEED 22 MPH

LENGTH OF RECORD 20.0 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1740	1492
20	1522	1292
30	1292	1074
40	990	819
50	609	504
60	296	221
70	87	80
80	16	15
90	4	1
100 = 1.2g	0	0

STATISTICAL DATA

VEHICLE: XM474 w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE ______ PSI

DATA CHANNEL: 15 PLANE: LONG			DATA CHANNEL: 16 PLANE: VERT.		
LOCATION: INSTRUMENT RACKS #2 #3			LOCATION TELETYPE TABLE		
ROAD SPEED: 22 MPH			ROAD SPEED 22 MPH		
LENGTH OF RECORD: 20.0 SECONDS			LENGTH OF RECORD 20.0 SECONDS		

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1889	2240	10	1836	1716
20	1380	1941	20	1541	1458
30	1089	1293	30	1077	887
40	818	808	40	766	679
50	572	398	50	422	344
60	330	112	60	200	131
70	111	14	70	69	32
80	12	0	80	18	4
90	2	0	90	2	0
100 = 2.2g	0	0	100 = 1.7g	0	0

STATISTICAL DATA

VEHICLE: XM474 -- w/Pershing Communication Pack WEIGHT 16,890 POUNDS

COURSE: PAVED TIRE PRESSURE . PSI

DATA CHANNEL: 17 PLANE: VERT

LOCATION: ENGINE GENERATOR

ROAD SPEED: 22 MPH

LENGTH OF RECORD: 20.0 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1366	1487
20	858	1091
30	260	655
40	193	297
50	88	100
60	19	41
70	5	19
80	8	10
90	0	4
100 = 0.34g	0	0

DATA CHANNEL: 18 PLANE: LONG.

LOCATION ENGINE Venerator

ROAD SPEED 22 MPH

LENGTH OF RECORD 20.0 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	1383	1401
20	1101	1157
30	579	794
40	325	515
50	166	247
60	45	90
70	11	34
80	0	7
90	0	2
100 = 0.33g	0	0

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STATISTICAL DATA

VEHICLE: XM474 w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 1 PLANE: VERT

LOCATION: SHELTER BASE

ROAD SPEED: 11 MPH

LENGTH OF RECORD: 10.4 SECONDS

Amplitude Level - %		No. of Times Level was Exceeded Plus	Minus
10		62	29
20		7	10
30		0	7
40		0	5
50		0	4
60		0	2
70		0	4
80		0	1
90		0	1
100 =	10 g	0	0

DATA CHANNEL: 2 PLANE: TRANS.

LOCATION SHELTER BASE

ROAD SPEED 11 MPH

LENGTH OF RECORD 10.4 SECONDS

Amplitude Level - %		No. of Times Level was Exceeded Plus	Minus
10		21	35
20		7	8
30		4	2
40		0	1
50		0	1
60		0	1
70		0	1
80		0	1
90		0	1
100 =	6.8 g	0	0

NOTE: Plus and Minus denote polarity of accelerometer but accelerometers were not necessarily oriented on test item with respect to plus being up, right or forward.

STATISTICAL DATA

VEHICLE: XM474 w/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 3 PLANE: LONG.	DATA CHANNEL: 4 PLANE: VERT.
LOCATION: SHELTER BASE	LOCATION OUTBOARD AIR CONDITIONER
ROAD SPEED: 11 MPH	ROAD SPEED 11 MPH
LENGTH OF RECORD: 10.4 SECONDS	LENGTH OF RECORD 10.4 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	26	27	10	52	88
20	13	5	20	29	29
30	4	2	30	21	16
40	4	2	40	16	5
50	3	2	50	11	5
60	4	2	60	9	3
70	3	2	70	6	3
80	2	0	80	3	2
90	1	0	90	2	0
100 = 13.4g	0	0	100 = 12g	0	0

ORDBG Form 8130-(0), 11 Jan 61 61-16-22

STATISTICAL DATA

VEHICLE: XM474 w/ PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 5 PLANE: TRANS.	DATA CHANNEL: 6 PLANE: LONG.
LOCATION: OUTBOARD AIR CONDITIONER	LOCATION OUTBOARD AIR CONDITIONER
ROAD SPEED: 11 MPH	ROAD SPEED 11 MPH
LENGTH OF RECORD: 10.4 SECONDS	LENGTH OF RECORD 10.4 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	134	155	10	44	42
20	59	72	20	18	20
30	37	41	30	7	15
40	27	26	40	7	9
50	19	20	50	4	7
60	12	17	60	3	7
70	7	12	70	1	5
80	2	6	80	0	4
90	0	2	90	0	2
100 = 8.9g	0	0	100 = 15g	0	0

STATISTICAL DATA

VEHICLE: XM474 w/ PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 7 PLANE: VERT.

LOCATION: INSTRUMENT RACK #4 & #5

ROAD SPEED: 11 MPH

LENGTH OF RECORD: ______ SECONDS

Amplitude Level - %		No. of Times Level was Exceeded Plus	Minus
10			
20			
30			
40	NO DATA		
50			
60			
70			
80			
90			
100 =			

DATA CHANNEL: 8 PLANE: TRANS.

LOCATION INSTRUMENT RACK #4 & #5

ROAD SPEED 11 MPH

LENGTH OF RECORD 10.4 SECONDS

Amplitude Level - %		No. of Times Level was Exceeded Plus	Minus
10		361	401
20		174	173
30		49	37
40		13	15
50		5	9
60		4	8
70		1	2
80		1	2
90		1	1
100 =	4.5g	0	0

ORDBG Form 8130-(0), 11 Jan 61

61-16-24

STATISTICAL DATA

VEHICLE: XM474 w/ PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 9 PLANE: LONG.

LOCATION: INSTRUMENT RACKS #4 & #5

ROAD SPEED: 11 MPH

LENGTH OF RECORD: 10.4 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	48	63
20	10	14
30	3	5
40	3	6
50	6	4
60	4	2
70	6	1
80	2	0
90	2	0
100 = 13g	0	0

DATA CHANNEL: 10 PLANE: VERT.

LOCATION KLYSTRON COAX

ROAD SPEED 11 MPH

LENGTH OF RECORD 10.4 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	47	75
20	11	19
30	8	7
40	5	3
50	3	2
60	4	1
70	2	0
80	1	0
90	1	0
100 = 10g	0	0

STATISTICAL DATA

VEHICLE: XM474 W/PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ____ PSI

DATA CHANNEL: 11 PLANE: TRANS.

LOCATION: KLYSTRON COAX

ROAD SPEED: 11 MPH

LENGTH OF RECORD: 10.4 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	87	86
20	18	22
30	15	15
40	9	7
50	6	4
60	3	2
70	3	2
80	1	0
90	1	0
100 = 8.0g	0	0

DATA CHANNEL: 12 PLANE: LONG

LOCATION KLYSTRON COAX

ROAD SPEED 11 MPH

LENGTH OF RECORD 10.4 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	41	32
20	8	7
30	4	3
40	3	2
50	2	1
60	2	1
70	2	1
80	1	0
90	1	0
100 = 14g	0	0

ORDBG Form 8130-(0), 11 Jan 61 61-16-26

STATISTICAL DATA

VEHICLE: XM474 w/ PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 13 PLANE: VERT

LOCATION: INSTRUMENT RACKS #2 & #3

ROAD SPEED: 11 MPH

LENGTH OF RECORD: 92 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	132	114
20	26	20
30	8	12
40	6	8
50	5	5
60	2	4
70	1	0
80	1	0
90	1	0
100 = 7.0 g	0	0

DATA CHANNEL: 14 PLANE: TRANS

LOCATION INSTRUMENT RACKS #2 & #3

ROAD SPEED 11 MPH

LENGTH OF RECORD 92 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	157	159
20	24	52
30	6	10
40	5	4
50	4	3
60	5	3
70	2	4
80	1	2
90	0	1
100 = 6.1 g	0	0

ORDBG Form 8130-(0), 11 Jan 61 61-16-27

STATISTICAL DATA

VEHICLE: XM474 - W/PERSHING COMMUNICATION PAK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ____ PSI

DATA CHANNEL: 15 PLANE: LONG

LOCATION: INSTRUMENT RACKS #2 & #3

ROAD SPEED: 11 MPH

LENGTH OF RECORD: 9.2 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	12	17
20	6	9
30	3	6
40	3	3
50	2	2
60	2	0
70	2	0
80	3	0
90	2	0
100 = 16g	0	0

DATA CHANNEL: 16 PLANE: VERT.

LOCATION TELETYPE TABLE

ROAD SPEED 11 MPH

LENGTH OF RECORD 9.2 SECONDS

Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	162	135
20	30	28
30	22	13
40	15	12
50	11	5
60	7	6
70	6	4
80	5	0
90	1	0
100 = 8.6g	0	0

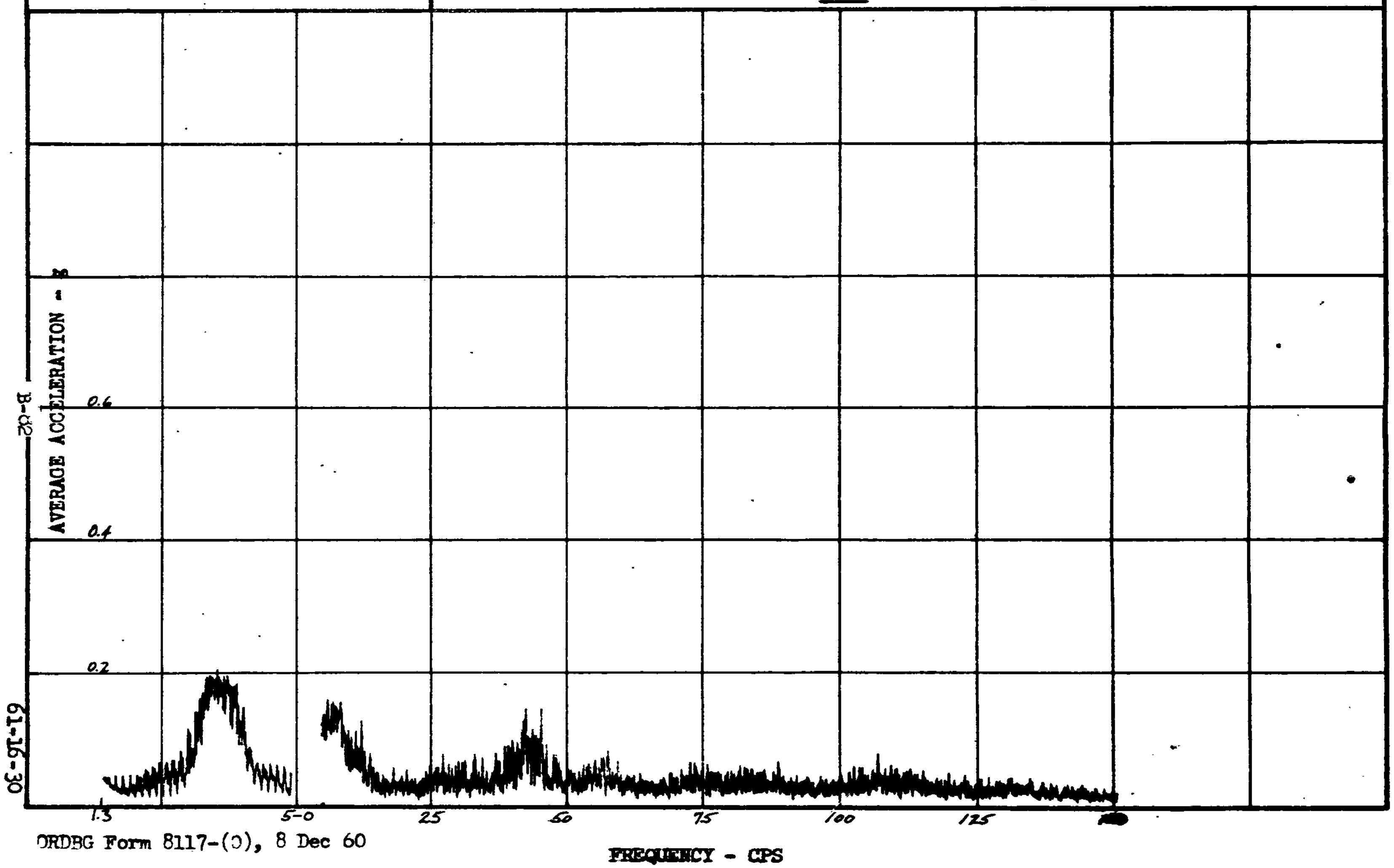
STATISTICAL DATA

VEHICLE: XM474 w/ PERSHING COMMUNICATION PACK WEIGHT 16,890 POUNDS

COURSE: RAMP TIRE PRESSURE ______ PSI

DATA CHANNEL: 17 PLANE: VERT.			DATA CHANNEL: 18 PLANE: LONG.		
LOCATION: ENGINE GENERATOR			LOCATION ENGINE GENERATOR		
ROAD SPEED: 11 MPH			ROAD SPEED 11 MPH		
LENGTH OF RECORD: 92 SECONDS			LENGTH OF RECORD 92 SECONDS		
Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus	Amplitude Level - %	No. of Times Level was Exceeded Plus	Minus
10	36	27	10	48	48
20	7	7	20	11	13
30	5	3	30	8	8
40	3	3	40	7	9
50	1	3	50	9	6
60	1	1	60	7	4
70	1	1	70	2	4
80	1	0	80	1	4
90	1	0	90	0	2
100 = 9.5g	0	0	100 = 7.1g	0	0

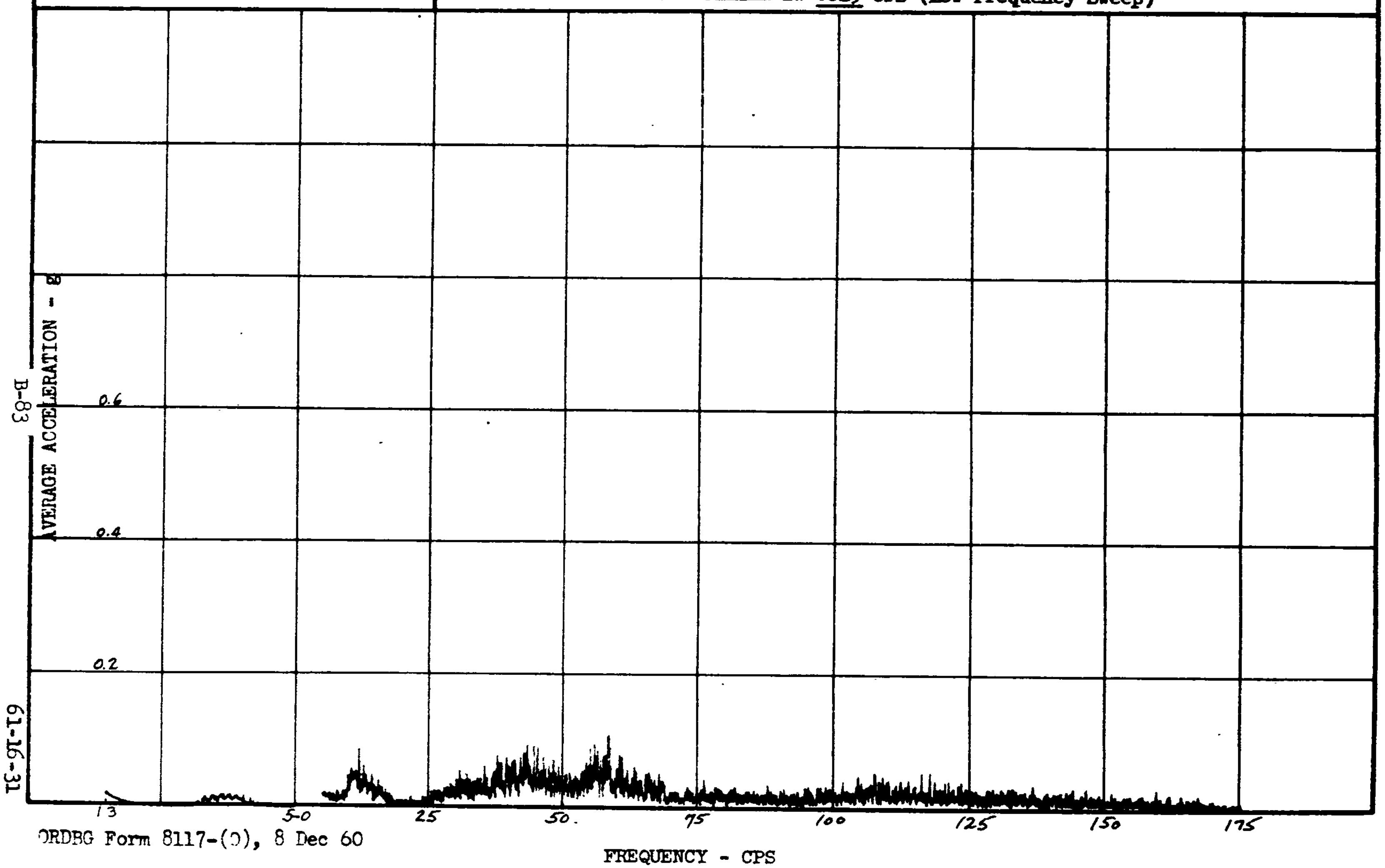
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING Communication Pack COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 1 PLANE VERT LOCATION SHELTER BASE RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-30

AUTOMOTIVE ENGINEERING LABORATORY	TEST OF XM474 -- W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH
DEVELOPMENT & PROOF SERVICES	CHANNEL Z PLANE TRANS LOCATION SHELTER BASE
ABERDEEN PROVING GROUND, MARYLAND	RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.
	EFF. FILTER BW .625 CPS (Low Frequency Sweep)

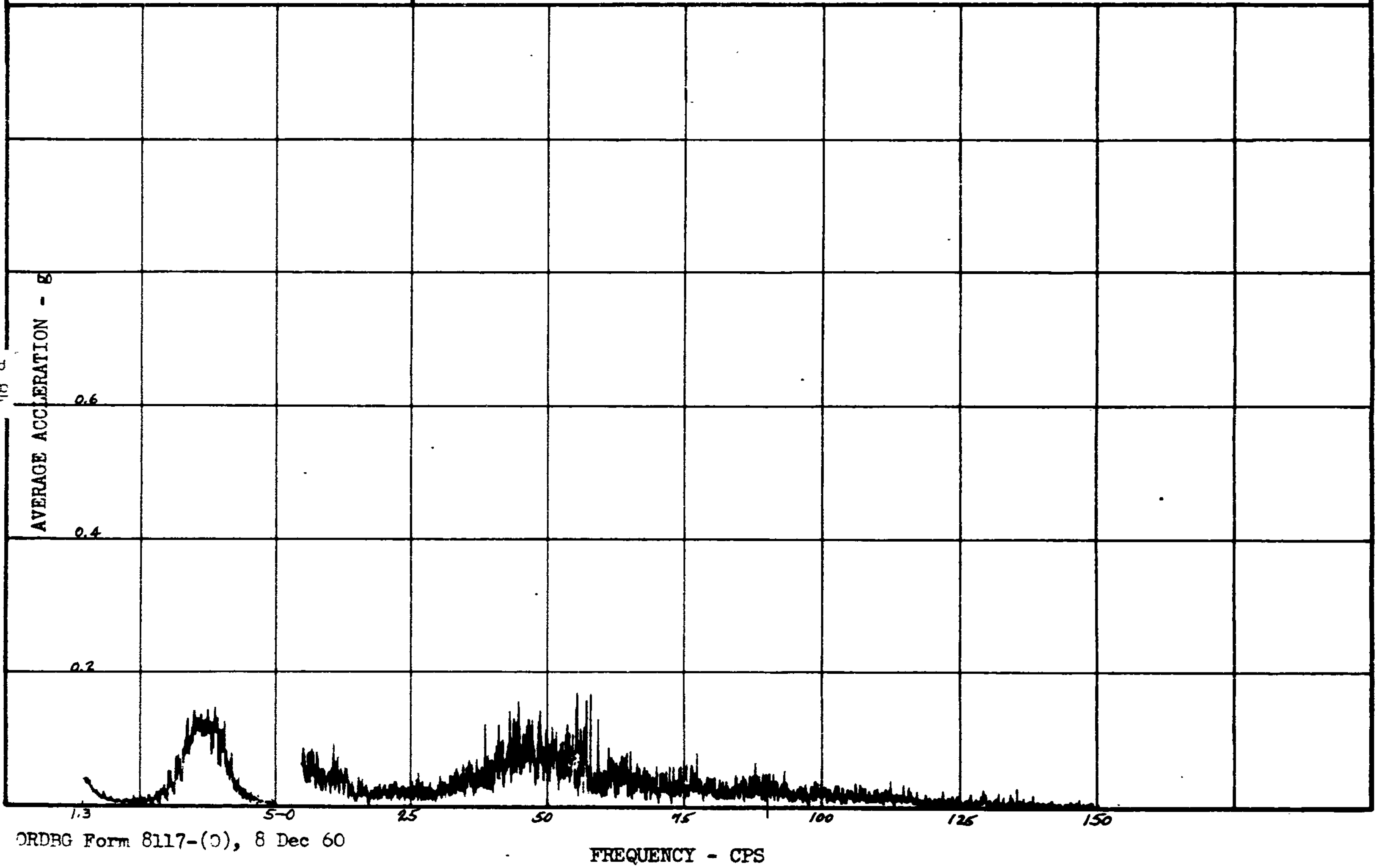


ORDBG Form 8117-(0), 8 Dec 60

61-16-31

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

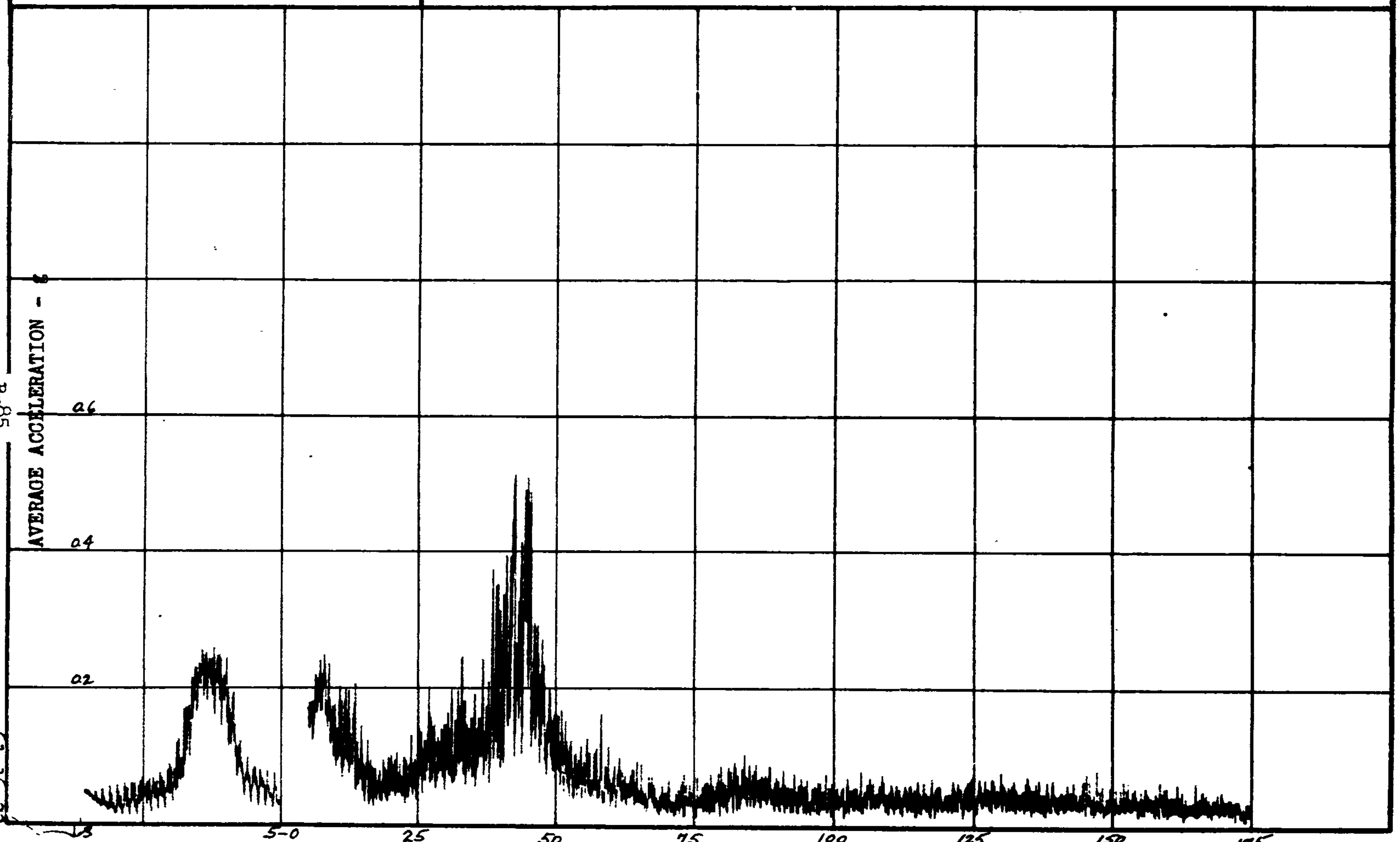
TEST OF XM474--W/PERSHING Communication Pack COURSE 6" Washboard SPEED 15 MPH
CHANNEL 3 PLANE Long. LOCATION SHELTER Base
RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.____
EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-32

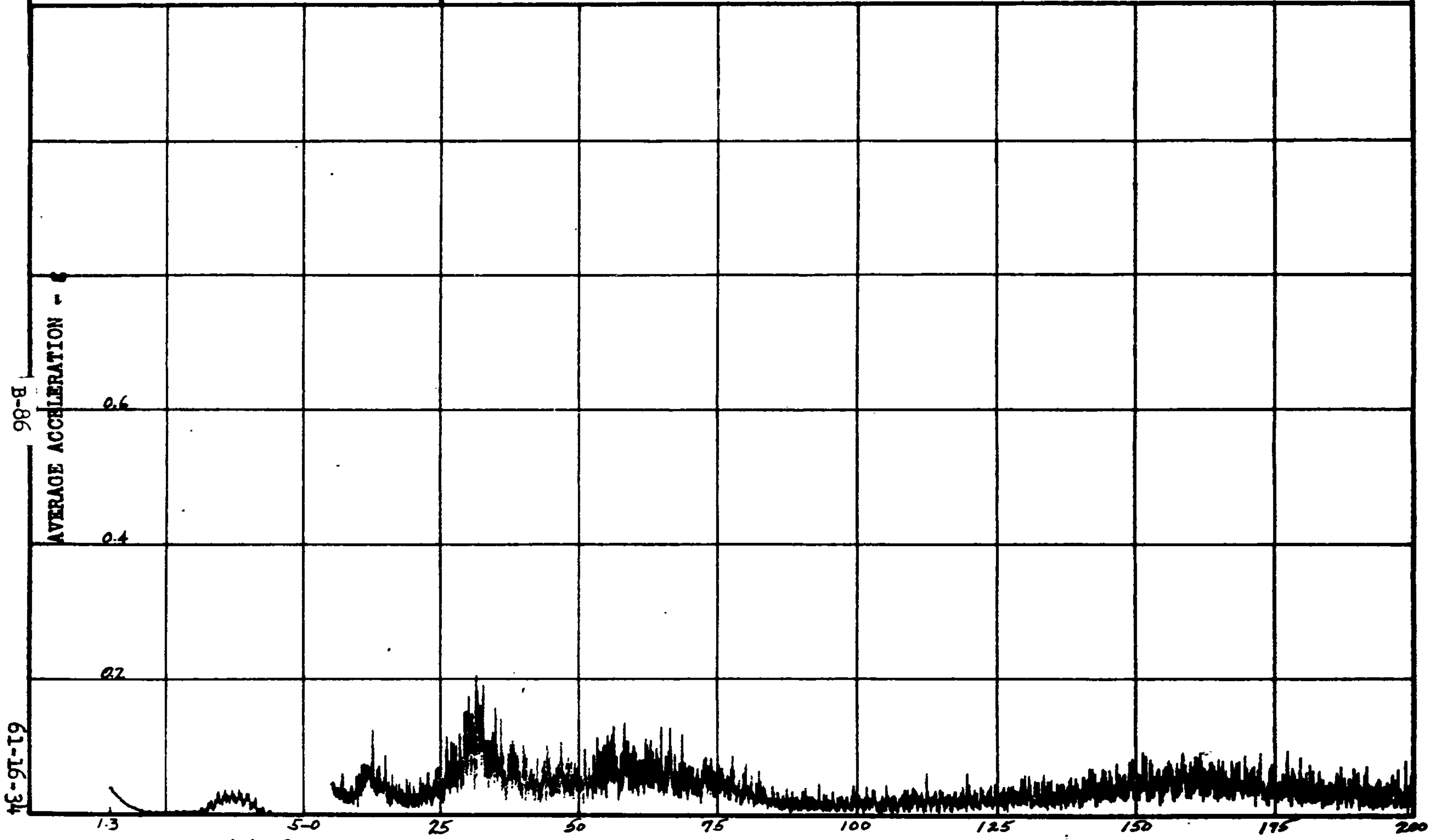
AUTOMOTIVE ENGINEERING LABORATORY	TEST OF XM474 W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH
DEVELOPMENT & PROOF SERVICES	CHANNEL 4 PLANE VERT. LOCATION AIR CONDITIONER - OUTBOARD
ABERDEEN PROVING GROUND, MARYLAND	RECORD 20/ SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ______ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-33

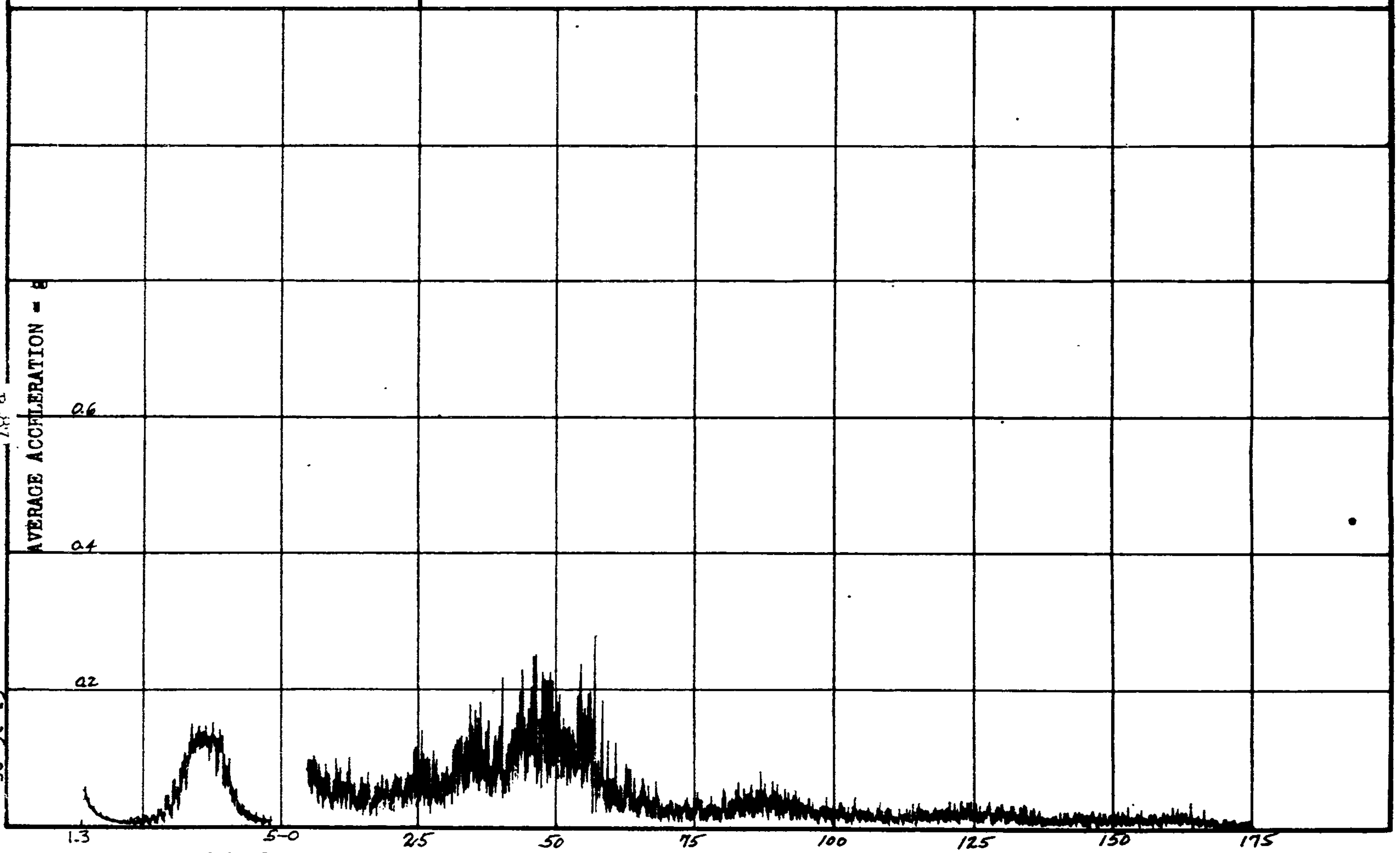
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 -- W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 5 PLANE TRANS LOCATION AIR CONDITIONER - OUTBOARD RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(0), 8 Dec 60

61-16-34

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF YM474 - W/PERSHING Communication Pack COURSE 6" Washboard SPEED 15 MPH CHANNEL 6 PLANE LONG. LOCATION Air Conditioner - Out Board RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)

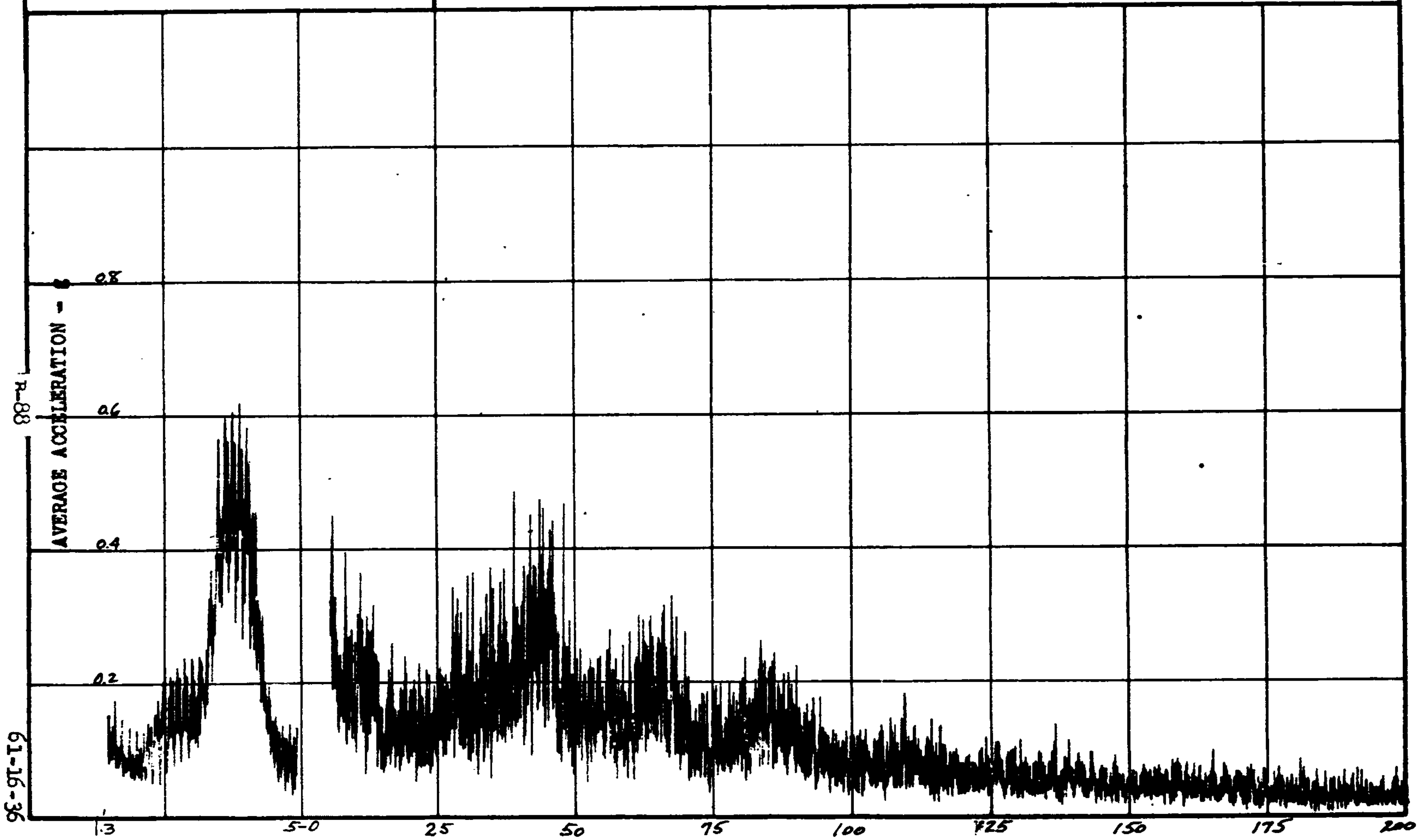


ORDBG Form 8117-(O), 8 Dec 60

B-87

61-16-35

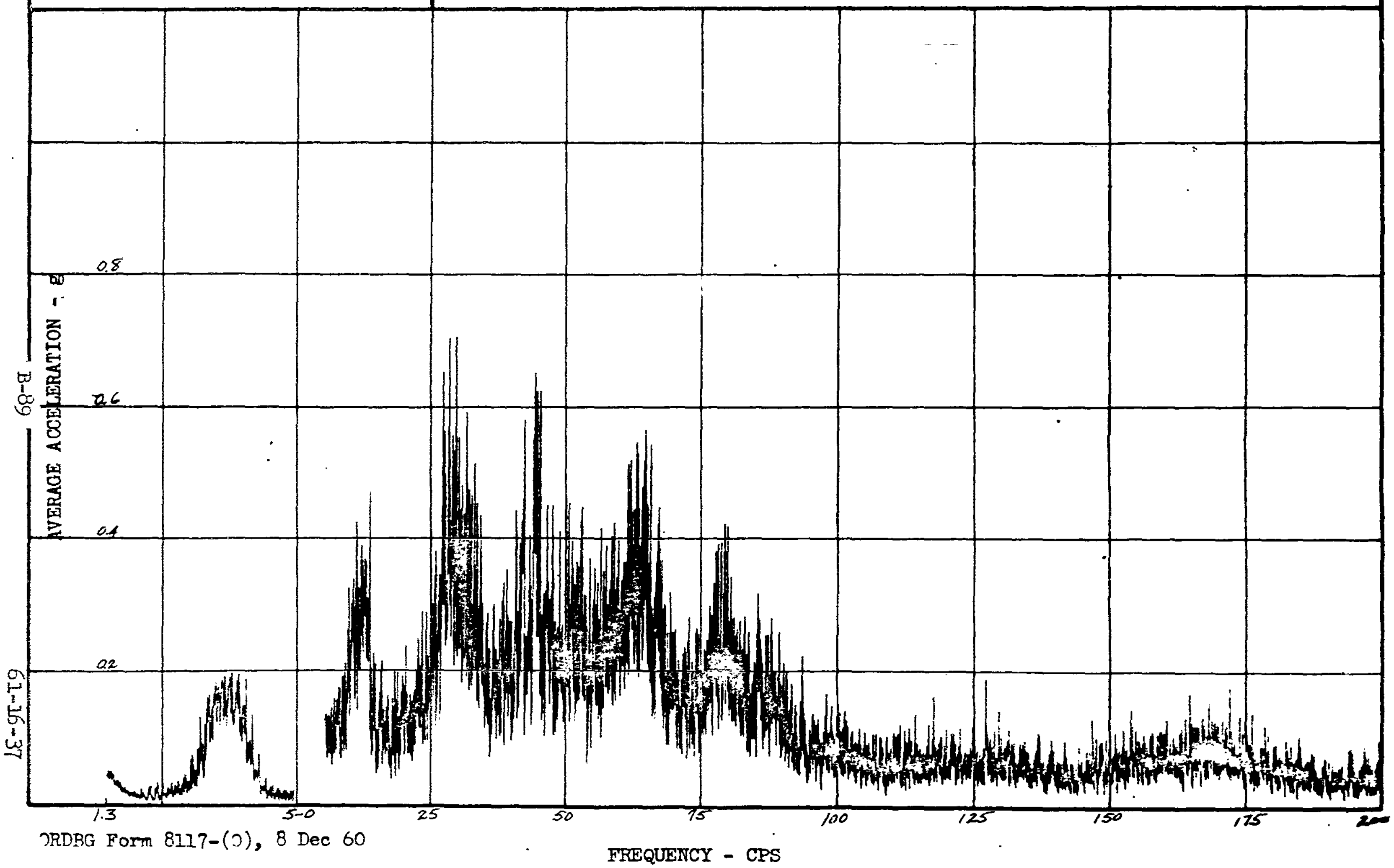
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474-- W/PERSHING Communication Pack COURSE 6" Washboard SPEED 15 MPH CHANNEL 7 PLANE VERT. LOCATION INSTRUMENT PACKS #4 & #5 RECORD 20./SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-36

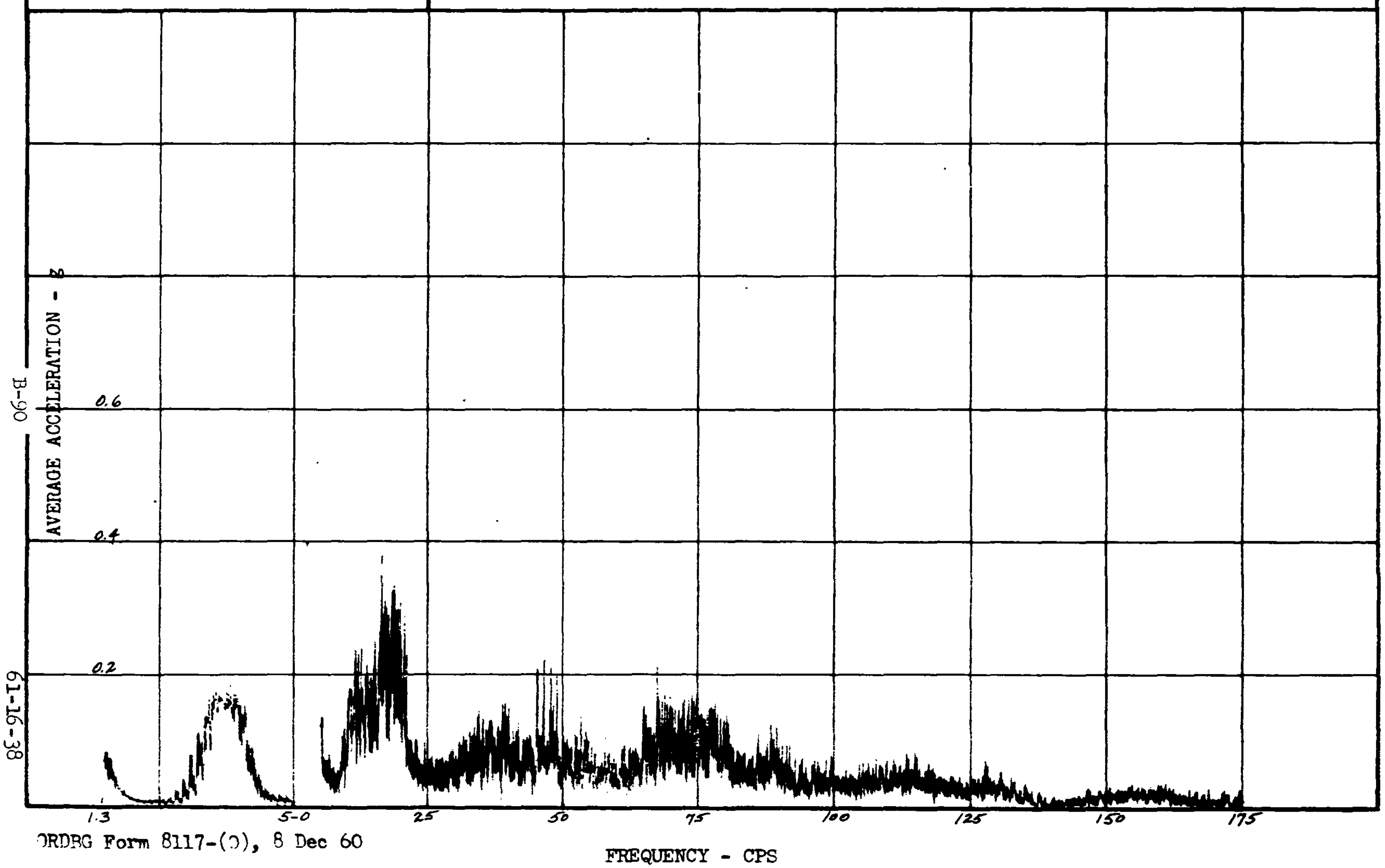
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 8 PLANE TRANS LOCATION INSTRUMENT PACKS #4 & #5 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-37

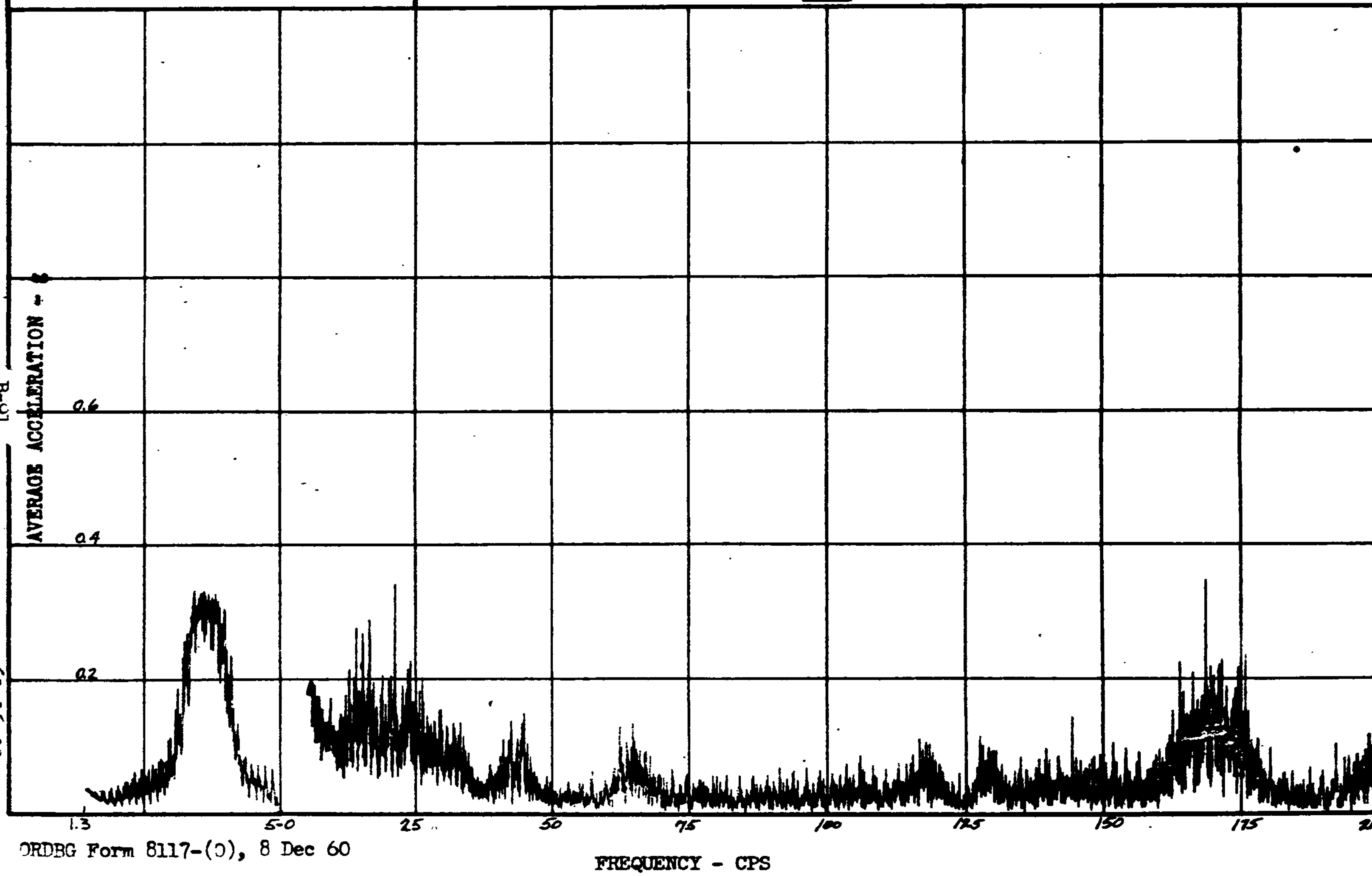
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 W/PERSHING COMMUNICATION PACK COURSE 6" WASH BOARD SPEED 15 MPH CHANNEL 9 PLANE LONG. LOCATION INSTRUMENT RACKS #4 & #5 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(0), 8 Dec 60

61-16-38

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474--W/PERSHING COMMUNICATION PACK COURSE 6"WASHBOARD SPEED 15 MPH CHANNEL 10 PLANE VERT LOCATION KLYSTRON COAX LINE RECORD 201 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. 1 of 2 EFF. FILTER BW .625 CPS (Low Frequency Sweep)

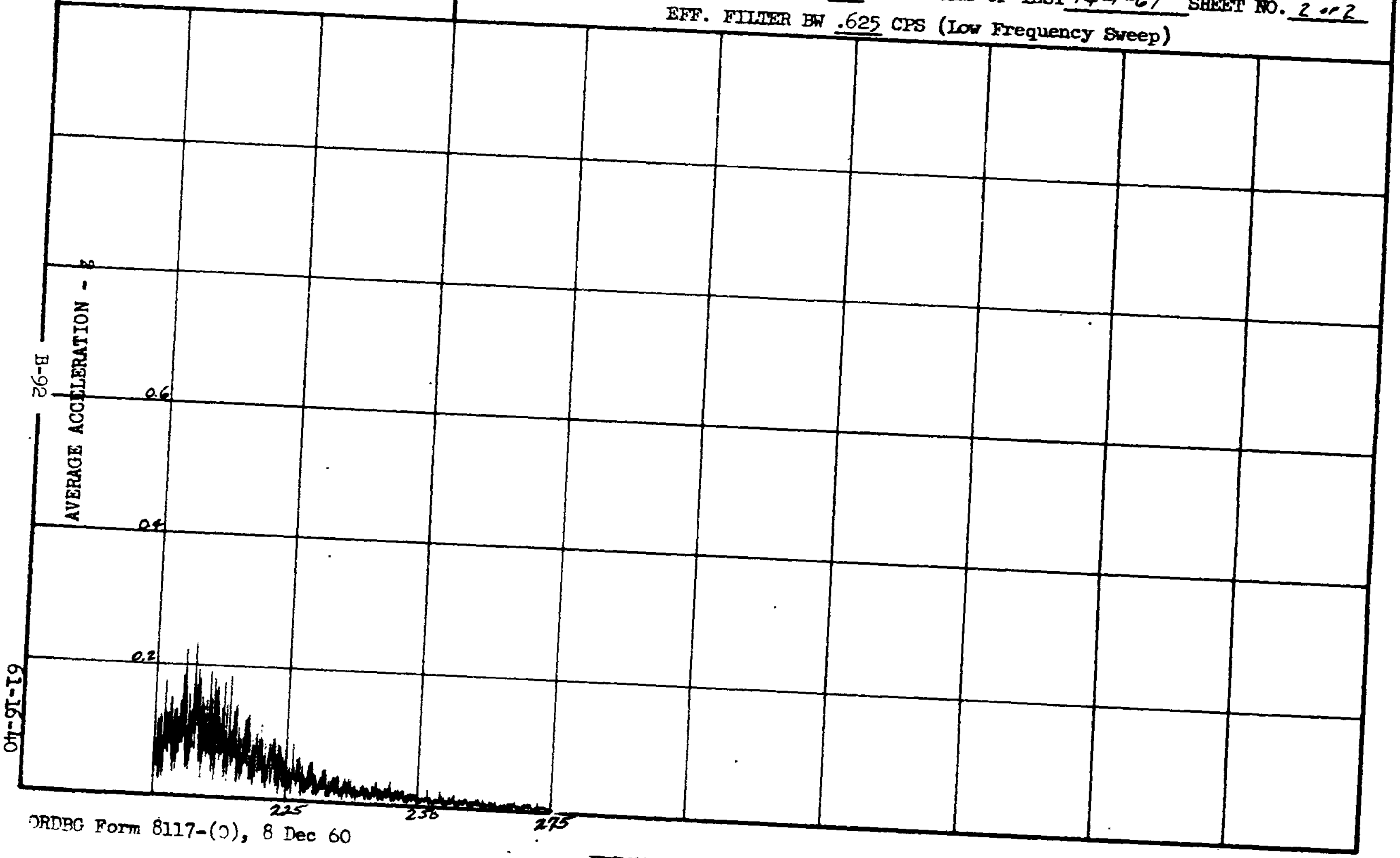


ORDBG Form 8117-(O), 8 Dec 60

61-16-39

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

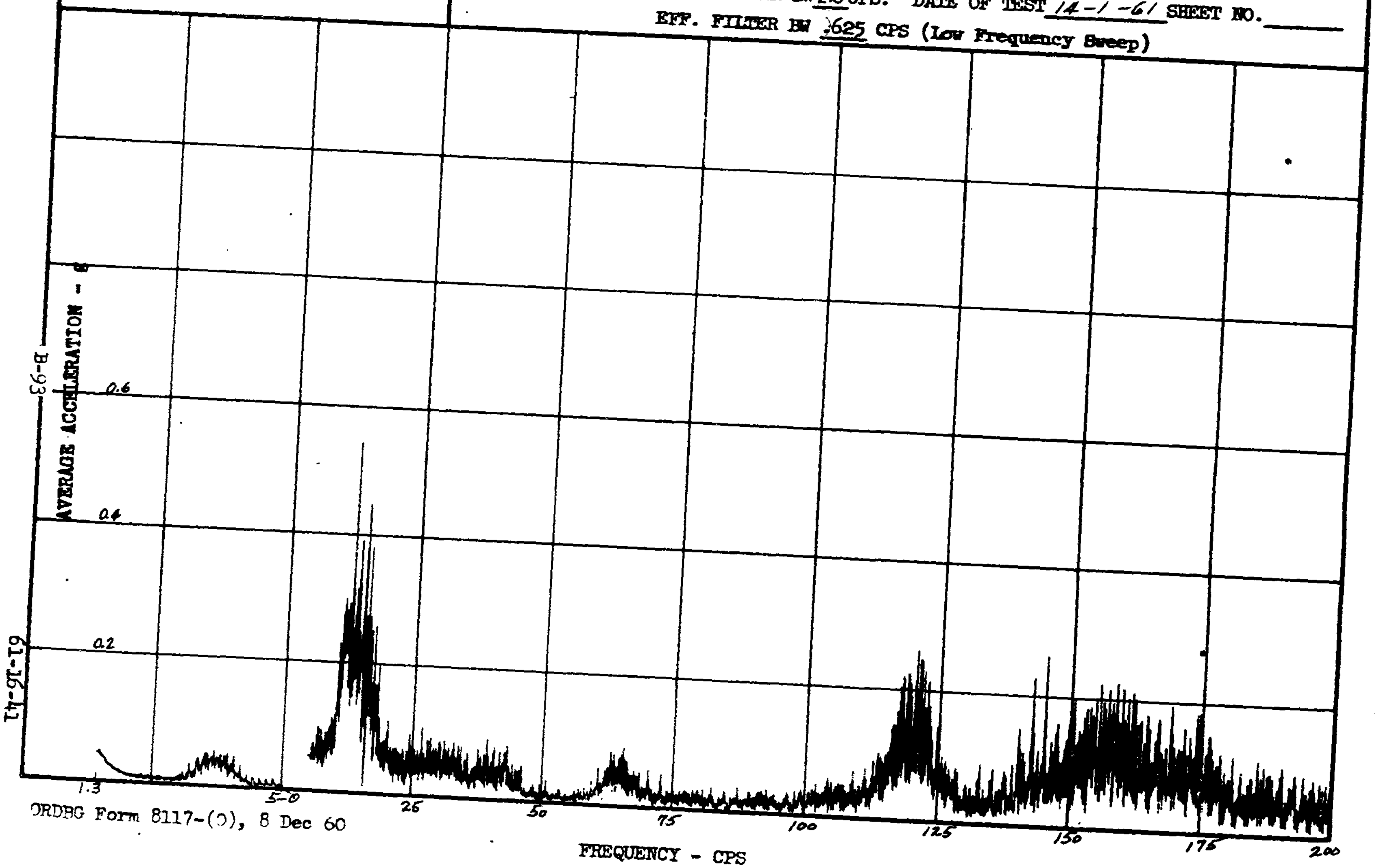
TEST OF XM474 W/Pershing Communication Pack COURSE 6" Washboard SPEED 15 MPH
CHANNEL 10 PLANE Vert LOCATION Klystron Coax Line
RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. 2 of 2
EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-40

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 -- W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 11 PLANE TRANS LOCATION KLYSTRON COAX LINE RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)

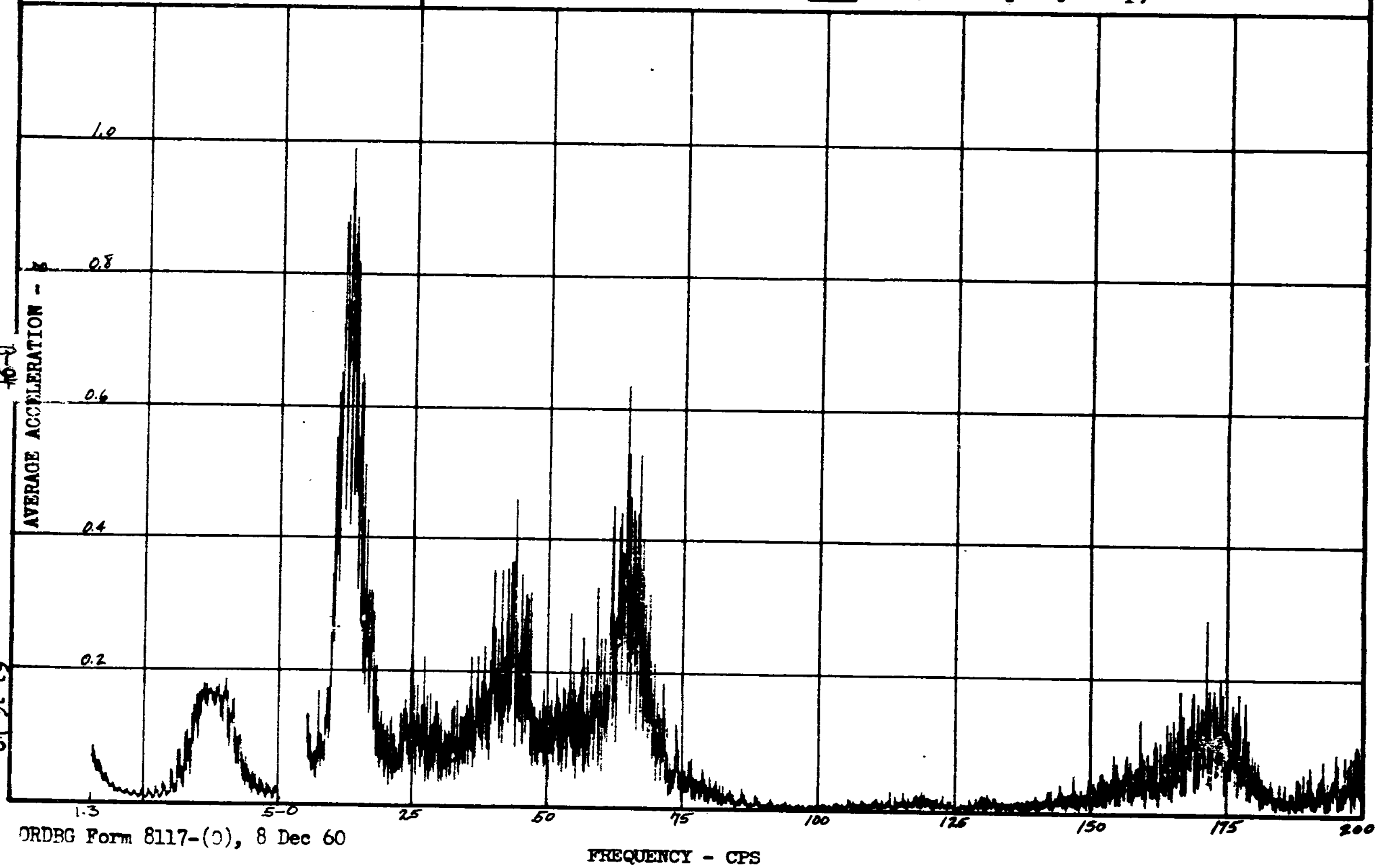


ORDBG Form 8117-(O), 8 Dec 60

B-93

61-16-41

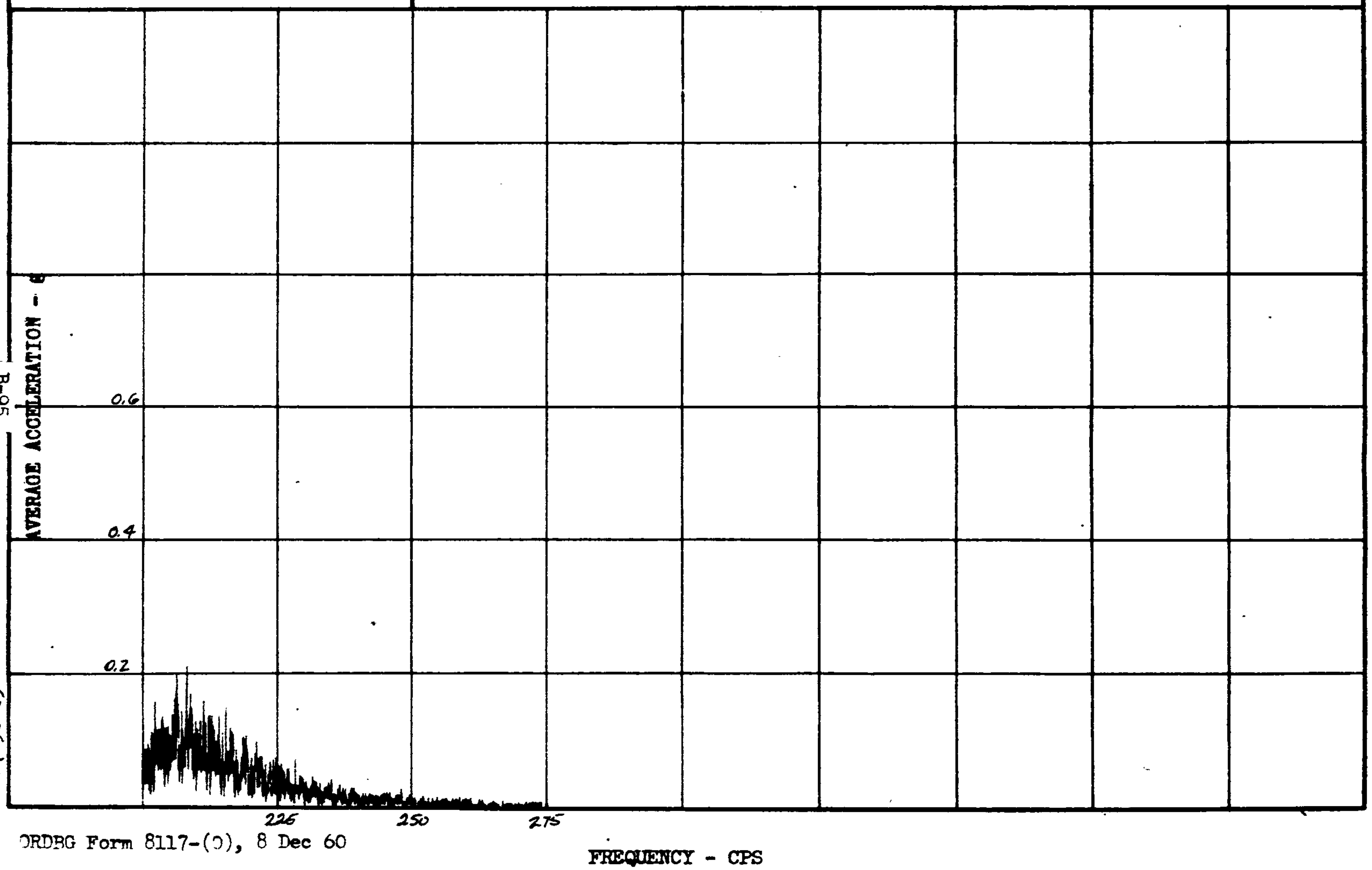
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 W/PERSHING Communication Pack COURSE 6" Washboard SPEED 15 MPH CHANNEL 12 PLANE Long. LOCATION KLYSTRON Coax Line RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. 1 of 2 EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-42

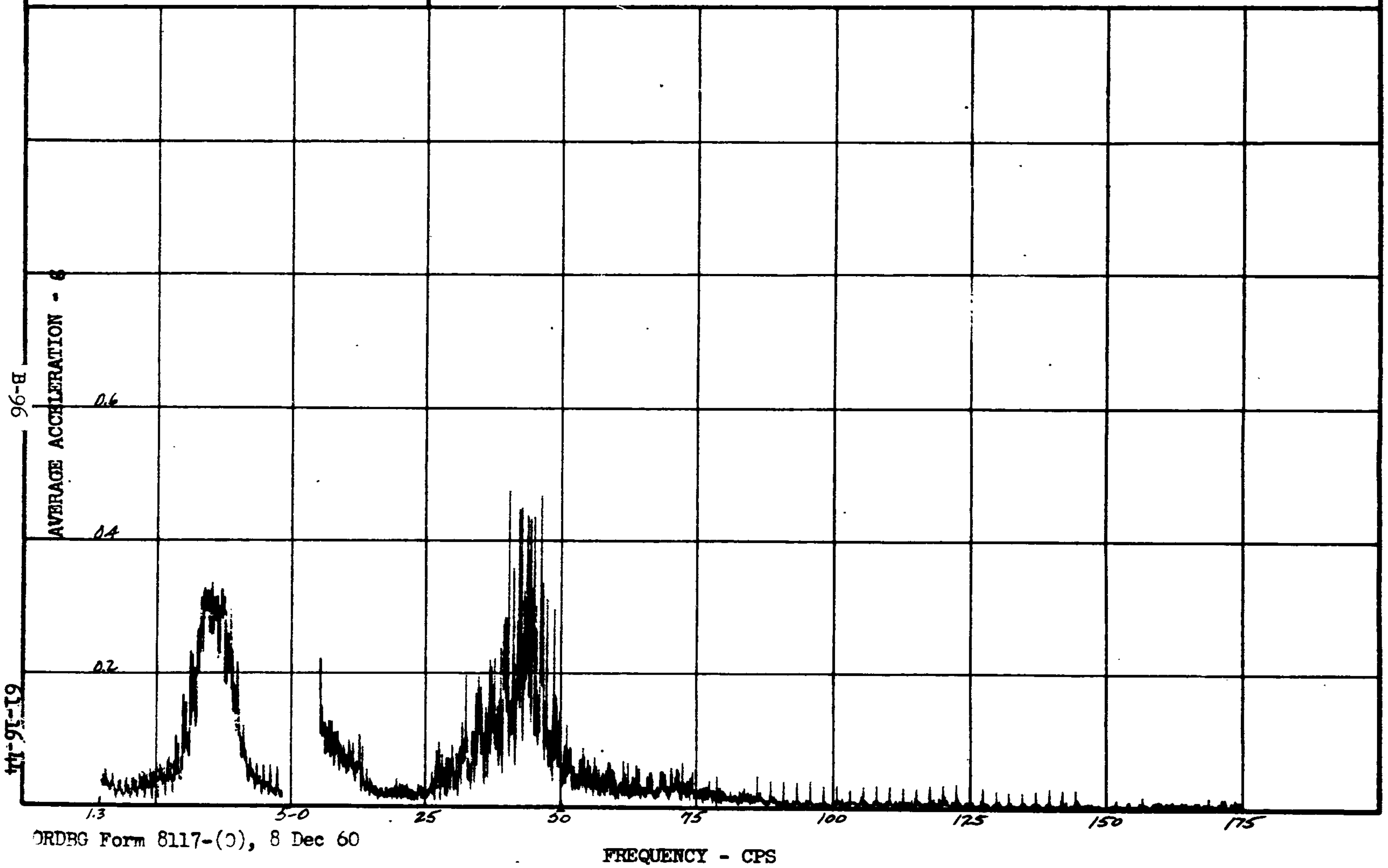
AUTOMOTIVE ENGINEERING LABORATORY	TEST OF XM474-- W/PERSHING Communication Pack COURSE 6" WASHBOARD SPEED 15 MPH
DEVELOPMENT & PROOF SERVICES	CHANNEL 12 PLANE LONG LOCATION KLYSTRON COAX LINE
ABERDEEN PROVING GROUND, MARYLAND	RECORD 201 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. 2 of 2 EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(D), 8 Dec 60

61-16-43

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 13 PLANE VERT. LOCATION INSTRUMENT RACKS #2 & #3 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)

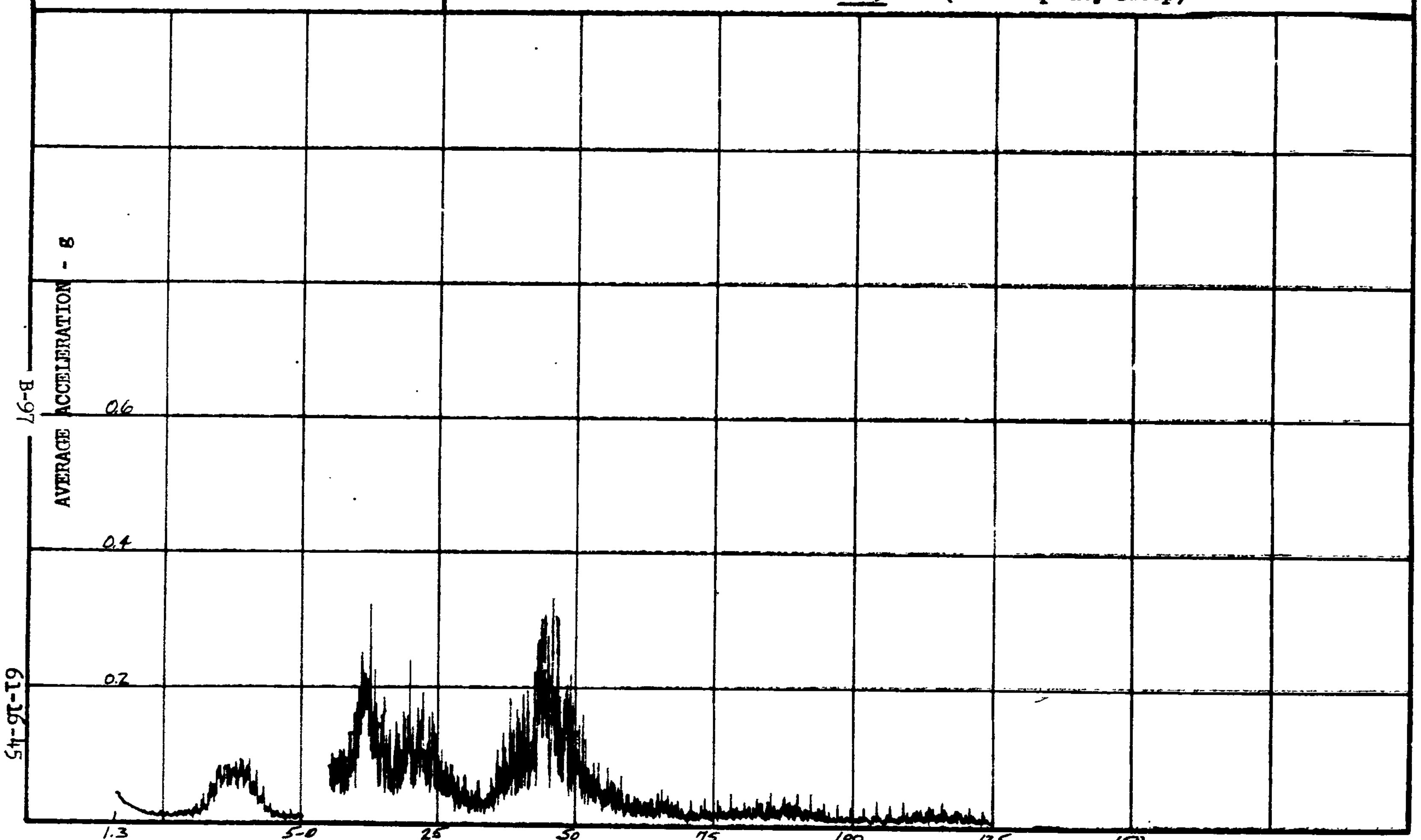


ORDBG Form 8117-(O), 8 Dec 60

61-16-44

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

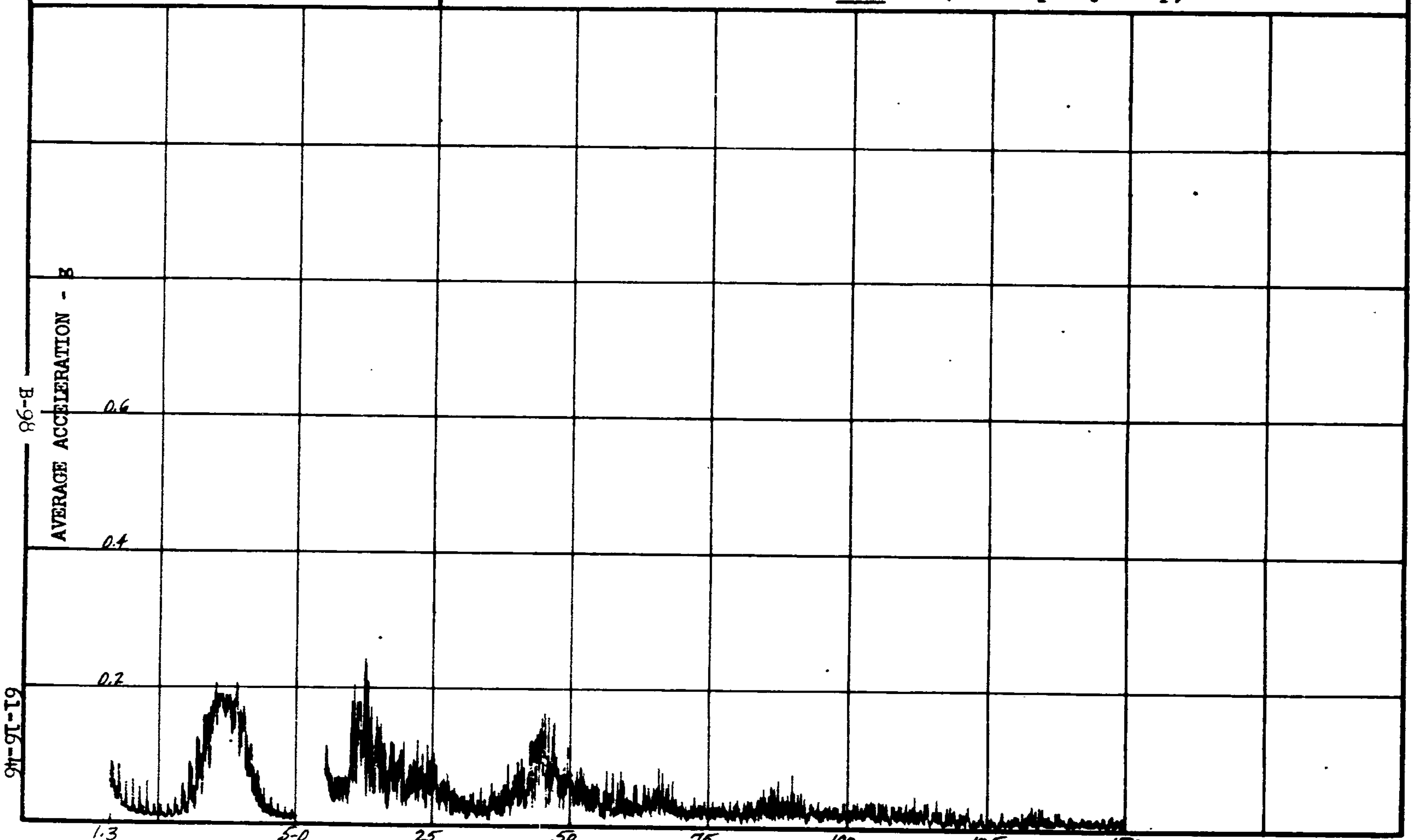
TEST OF XM474 - w/Pershing Communication Pack COURSE 6" WASHBOARD SPEED 15 MPH
CHANNEL 14 PLANE Trans LOCATION INSTRUMENT Racks #2 & #3
RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.
EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-45

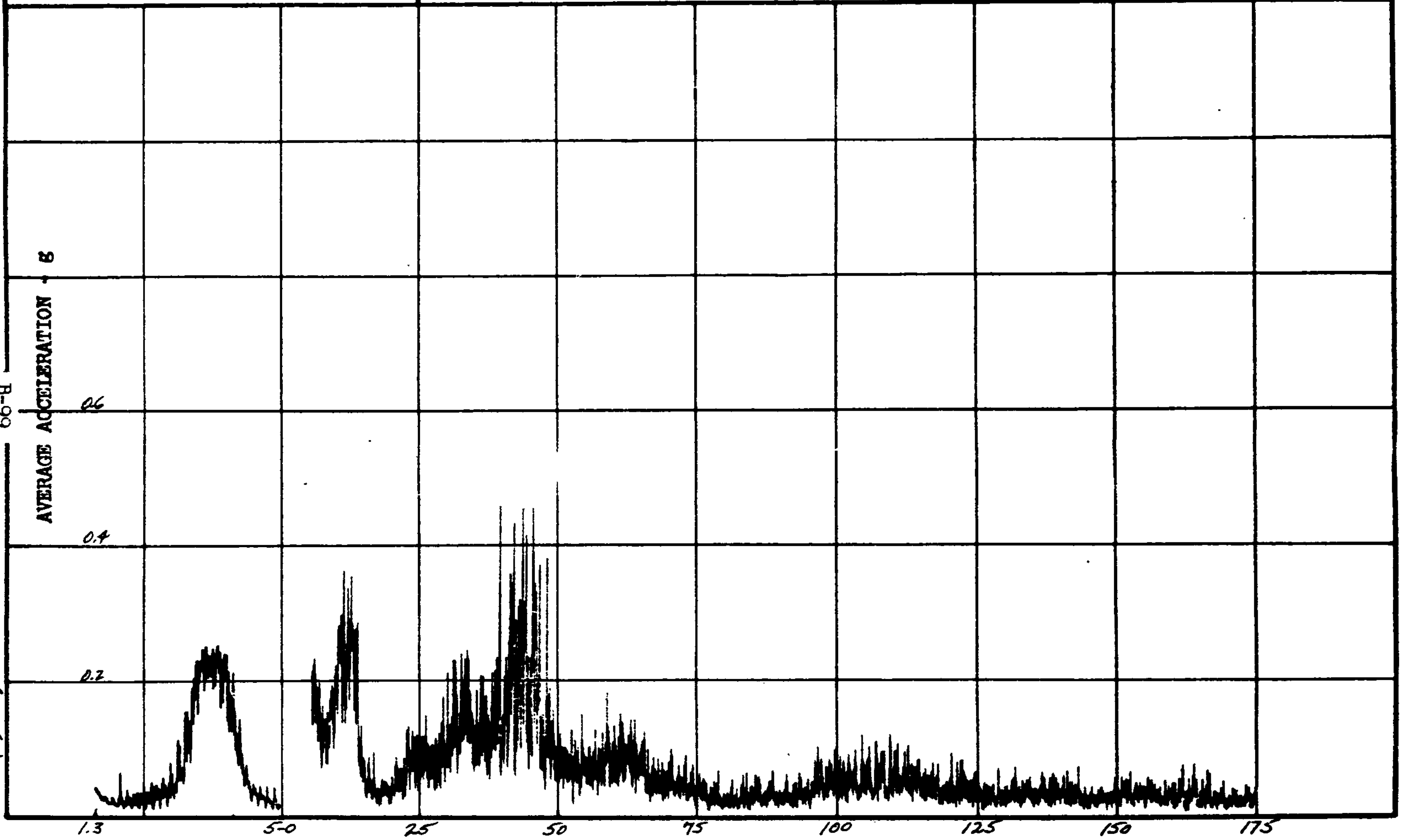
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING Communication Pack COURSE 6" Washboard SPEED 15 MPH CHANNEL 15 PLANE LONG LOCATION INSTRUMENT RACKS #2 & #3 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ______ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-46

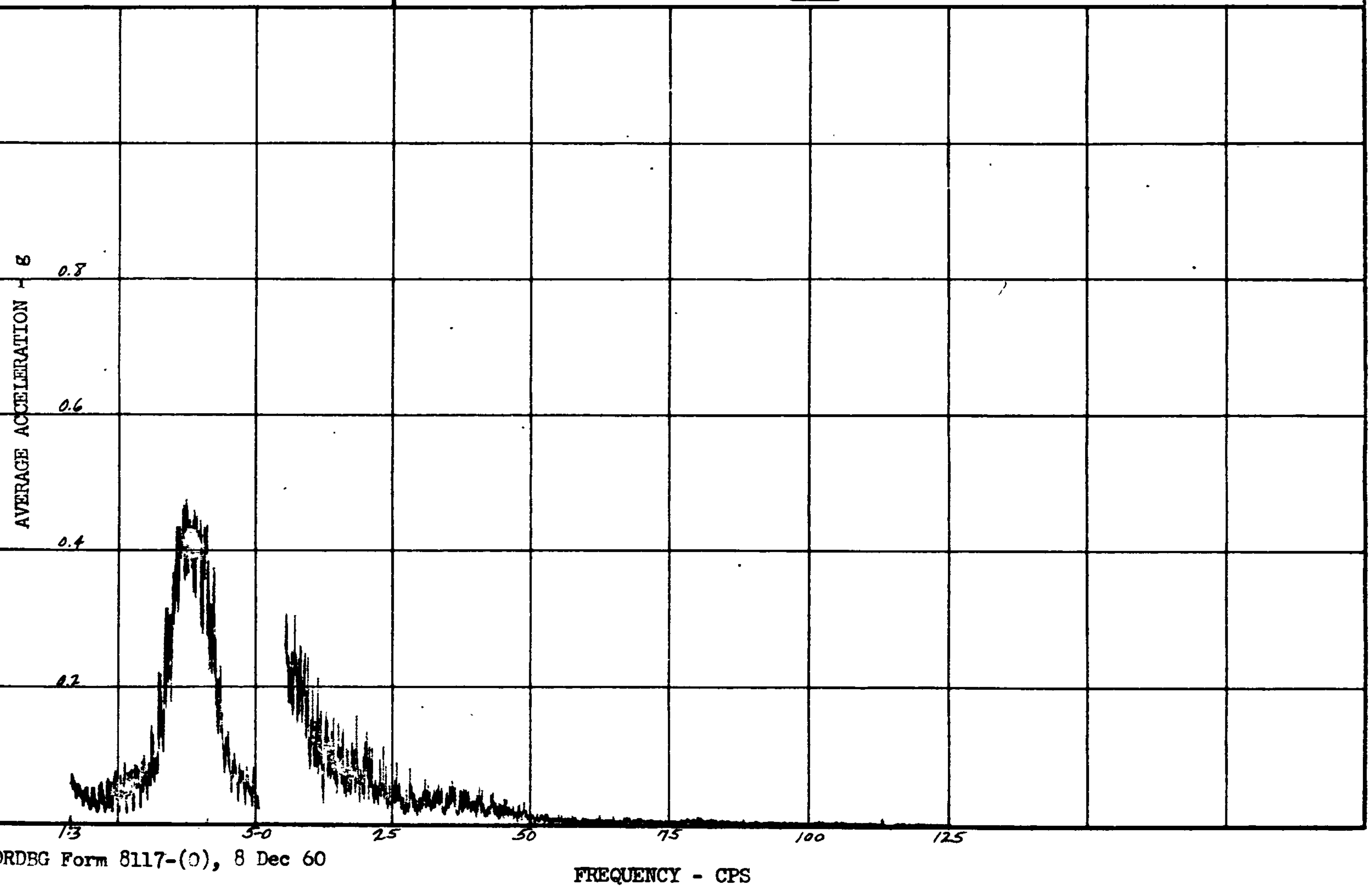
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING Communication Pack COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 16 PLANE VERT LOCATION TELETYPE TABLE RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(O), 8 Dec 60

61-16-47

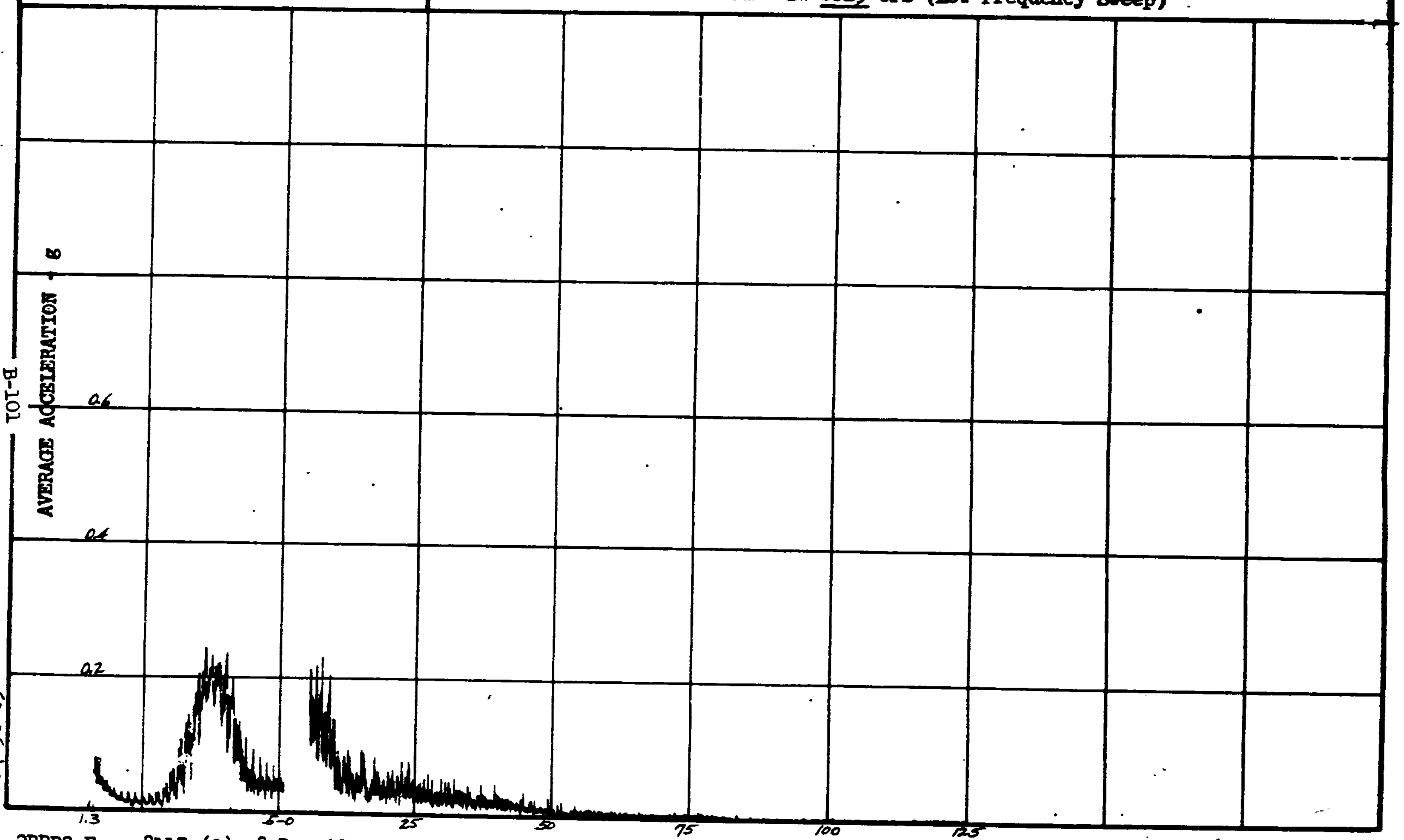
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 17 PLANE VERT. LOCATION ENGINE - GENERATOR RECORD 201 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____ EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(0), 8 Dec 60

61-16-48

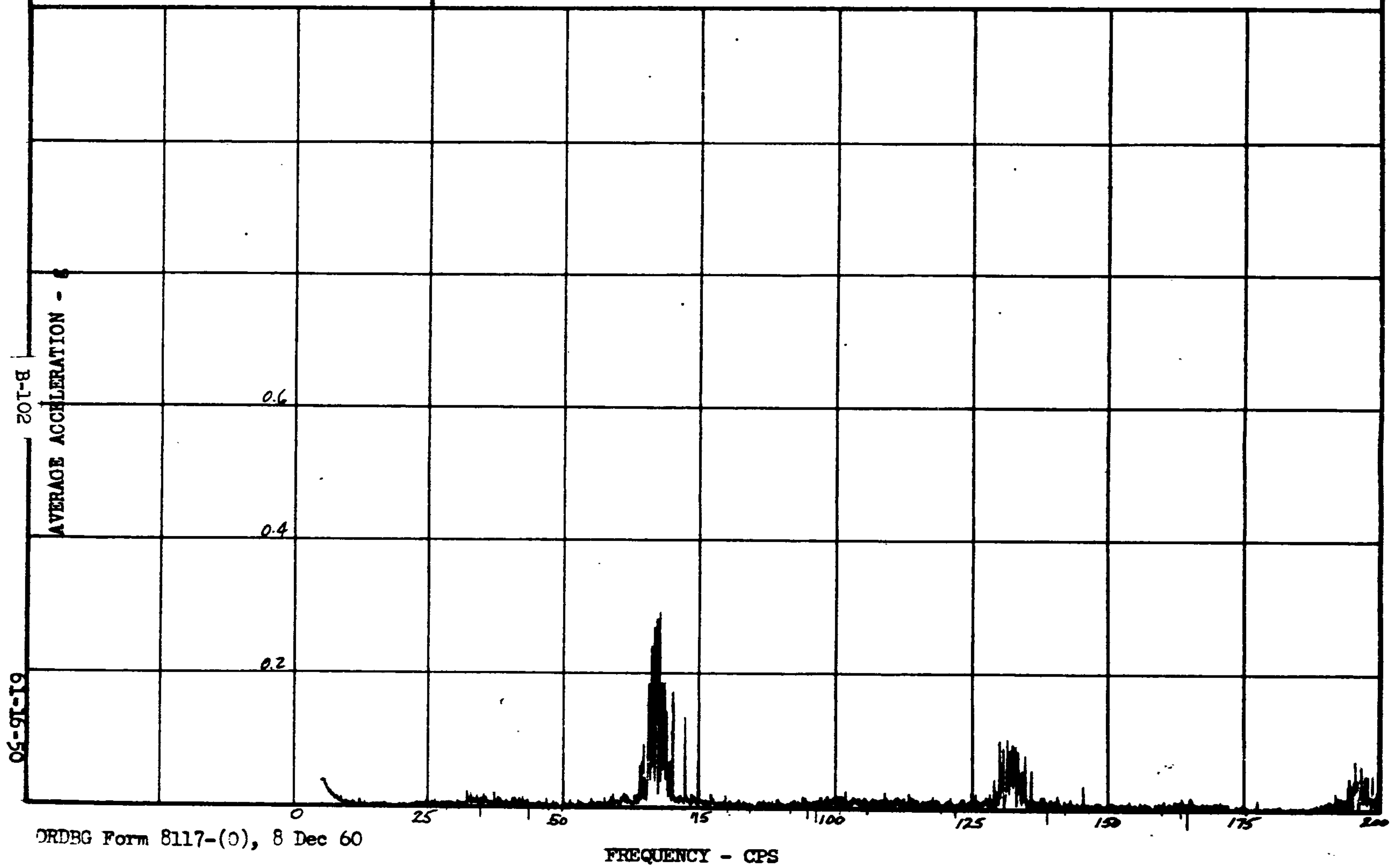
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE 6" WASHBOARD SPEED 15 MPH CHANNEL 18 PLANE LONG LOCATION ENGINE - GENERATOR RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. EFF. FILTER BW .625 CPS (Low Frequency Sweep)



ORDBG Form 8117-(D), 8 Dec 60

61-16-49

AUTOMOTIVE ENGINEERING LABORATORY	TEST OF XM474--W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH
DEVELOPMENT & PROOF SERVICES	CHANNEL 1 PLANE VERT LOCATION SHELTER BASE
ABERDEEN PROVING GROUND, MARYLAND	RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(O), 8 Dec 60

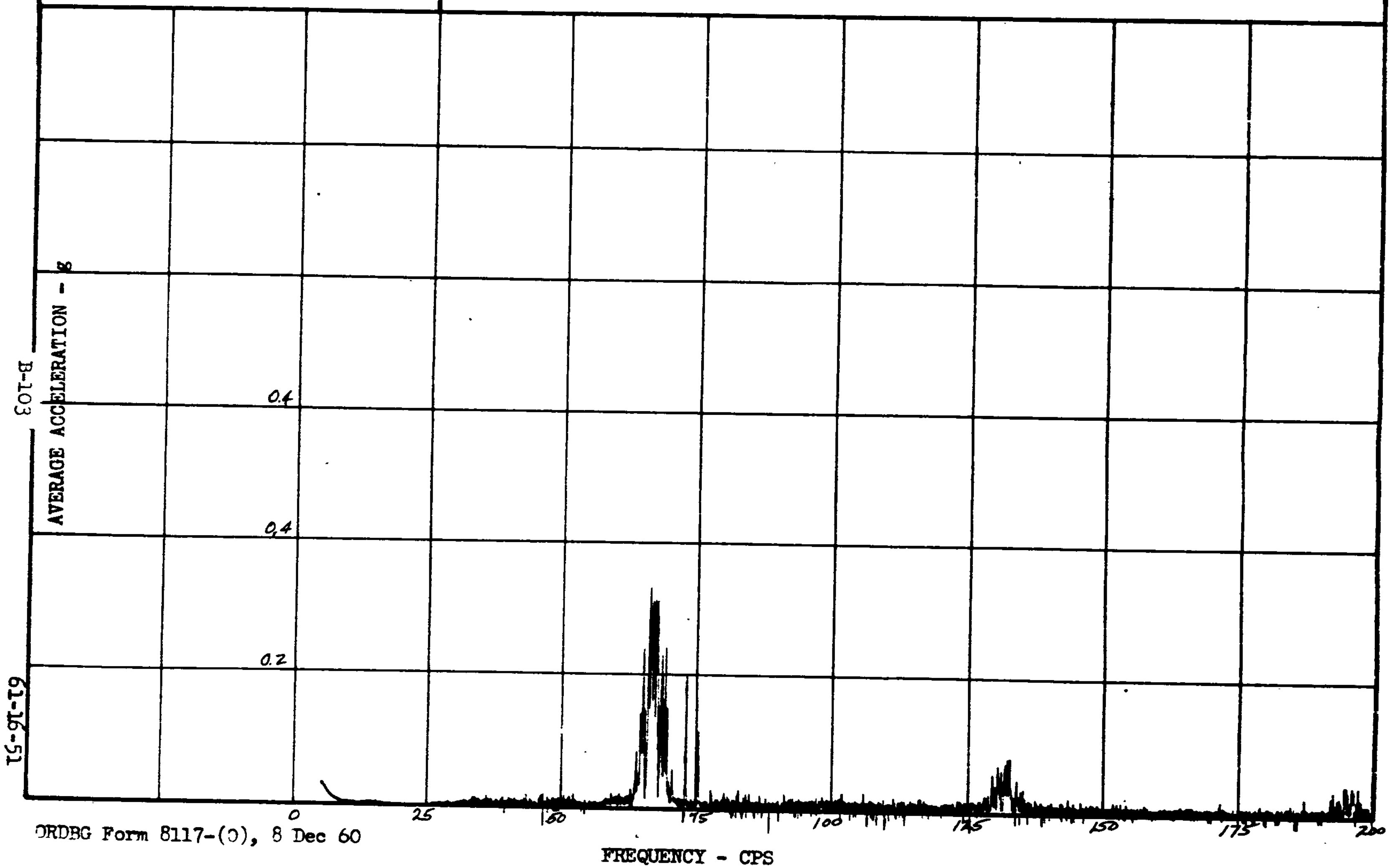
61-16-50

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

TEST OF XM474--W/PERSHING Communication Pack COURSE Paved SPEED 22 MPH

CHANNEL 2 PLANE Trans LOCATION SHELTER BASE

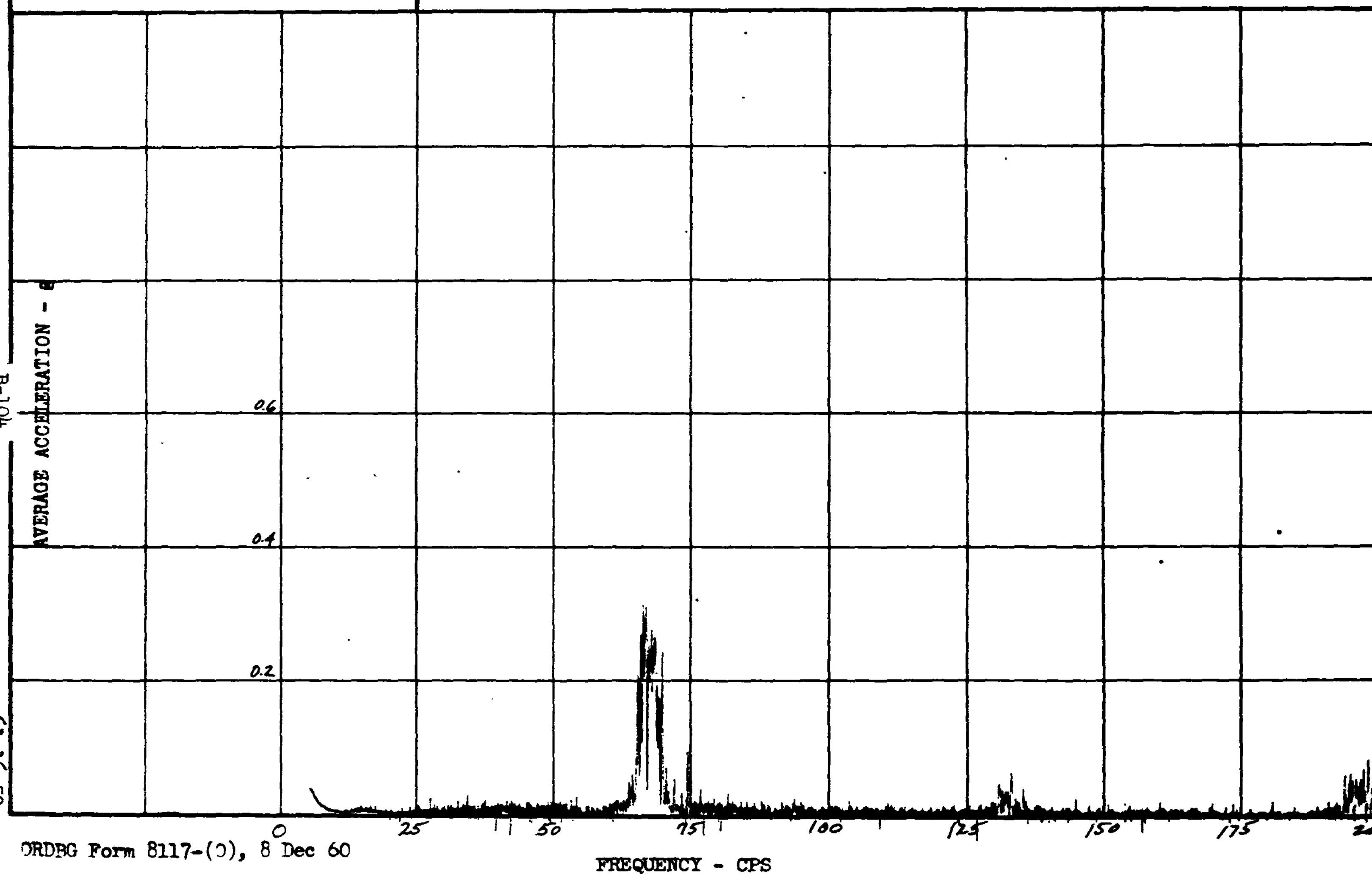
RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(O), 8 Dec 60

61-16-51

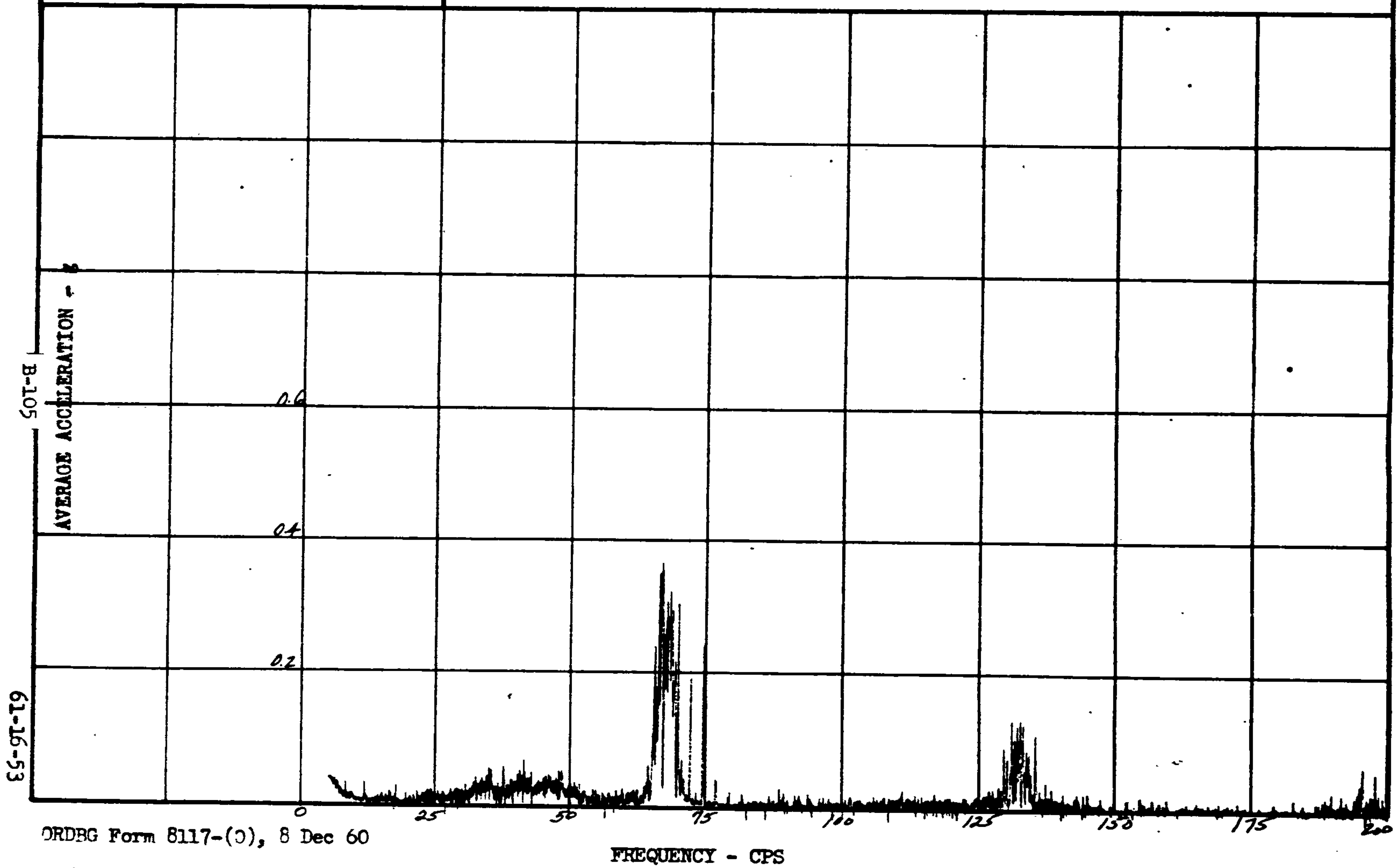
AUTOMOTIVE ENGINEERING LABORATORY	TEST OF XM474-- W/PERSHING Communication Pk COURSE PAVED SPEED 22 MPH
DEVELOPMENT & PROOF SERVICES	CHANNEL 3 PLANE LONG. LOCATION SHELTER BASE
ABERDEEN PROVING GROUND, MARYLAND	RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.



ORDBG Form 8117-(O), 8 Dec 60

61-16-52

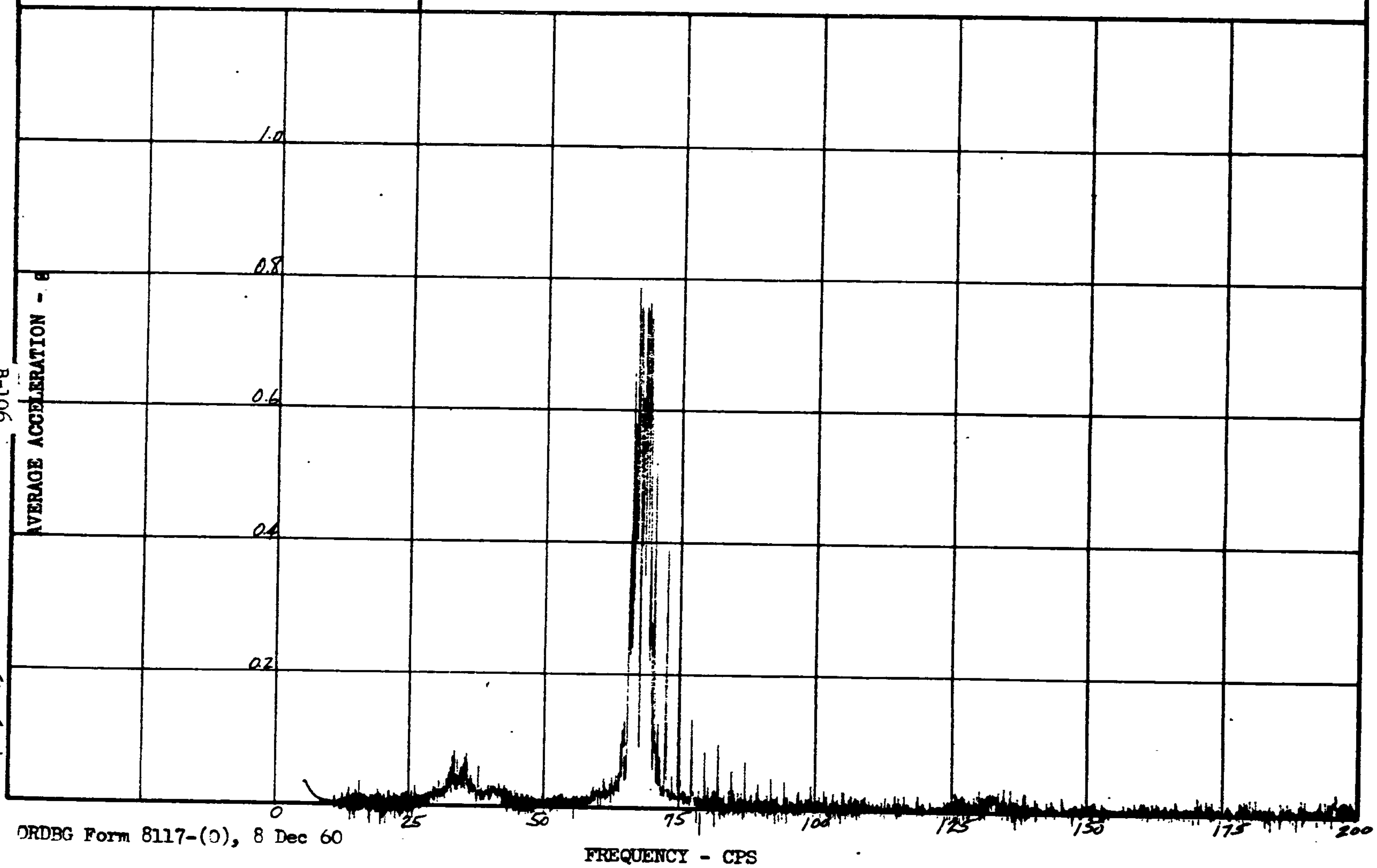
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/Pershing Communication Pack COURSE Paved SPEED 22 MPH CHANNEL 4 PLANE VERT. LOCATION Air Conditioner - Out Board RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.



ORDBG Form 8117-(O), 8 Dec 60

61-16-53

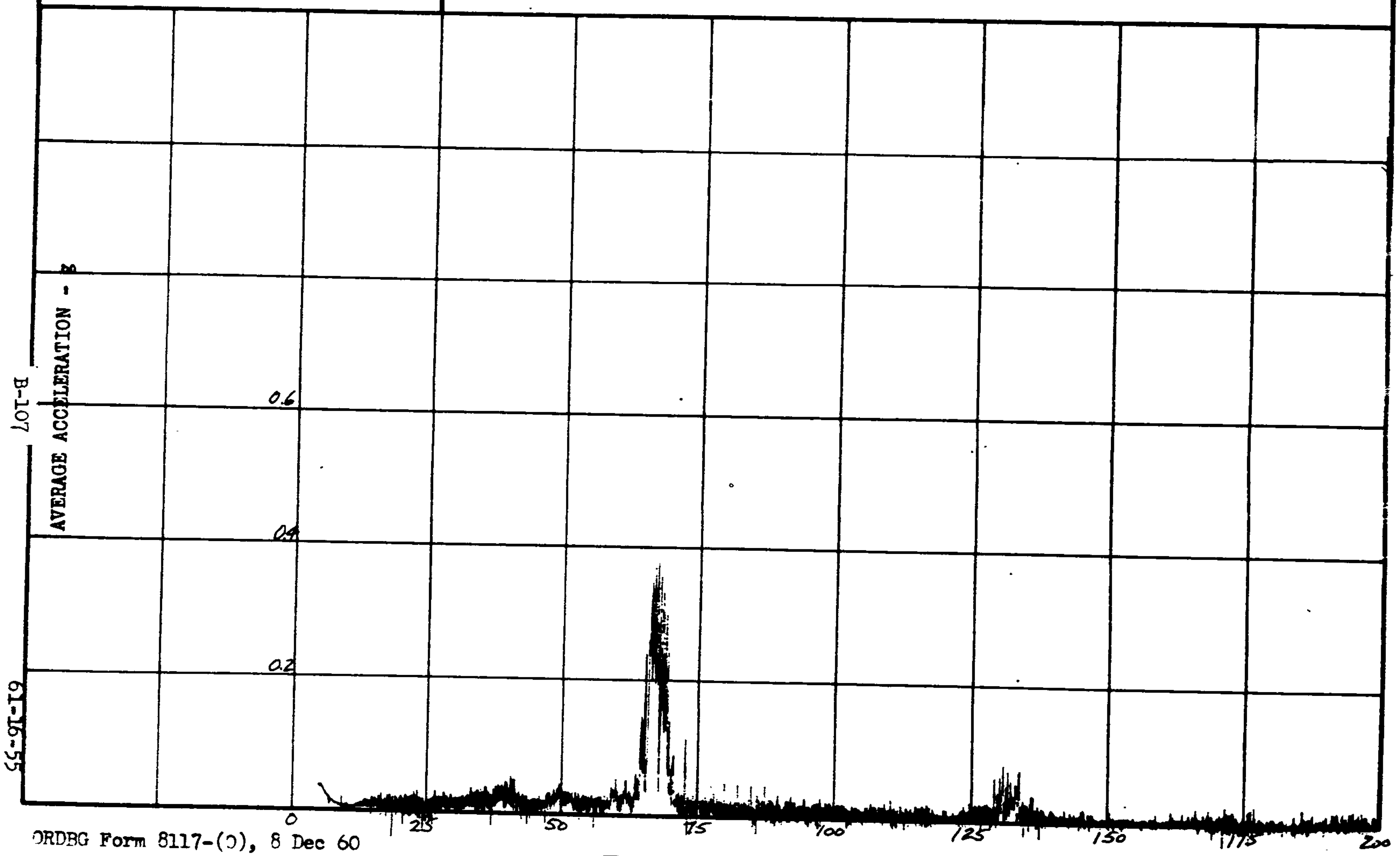
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 5 PLANE TRANS LOCATION AIR CONDITIONER - OUTBOARD RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.



ORDBG Form 8117-(0), 8 Dec 60

61-16-54

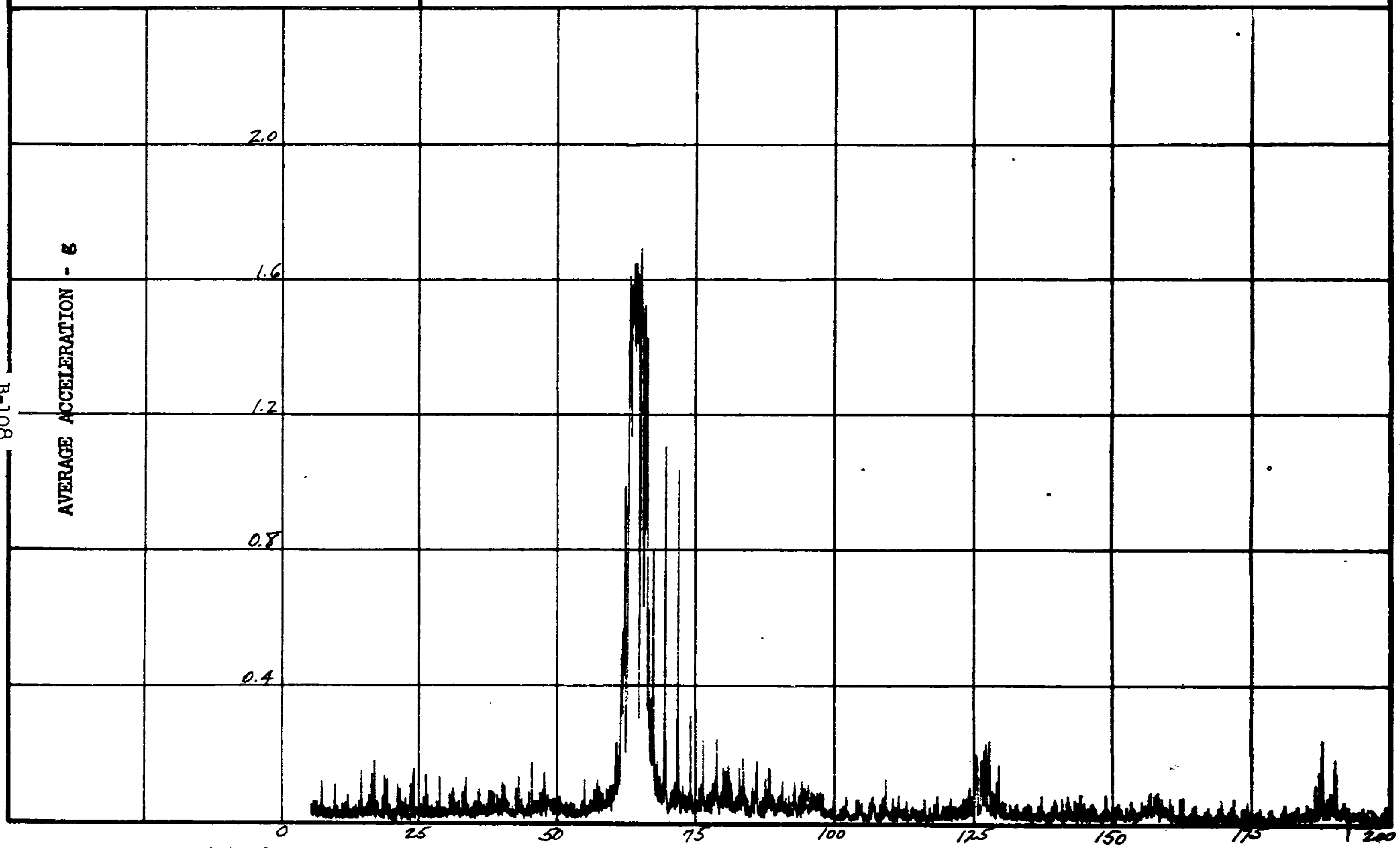
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 6 PLANE LONG LOCATION AIR CONDITIONER - OUTBOARD RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.



ORDBG Form 8117-(O), 8 Dec 60

61-16-55

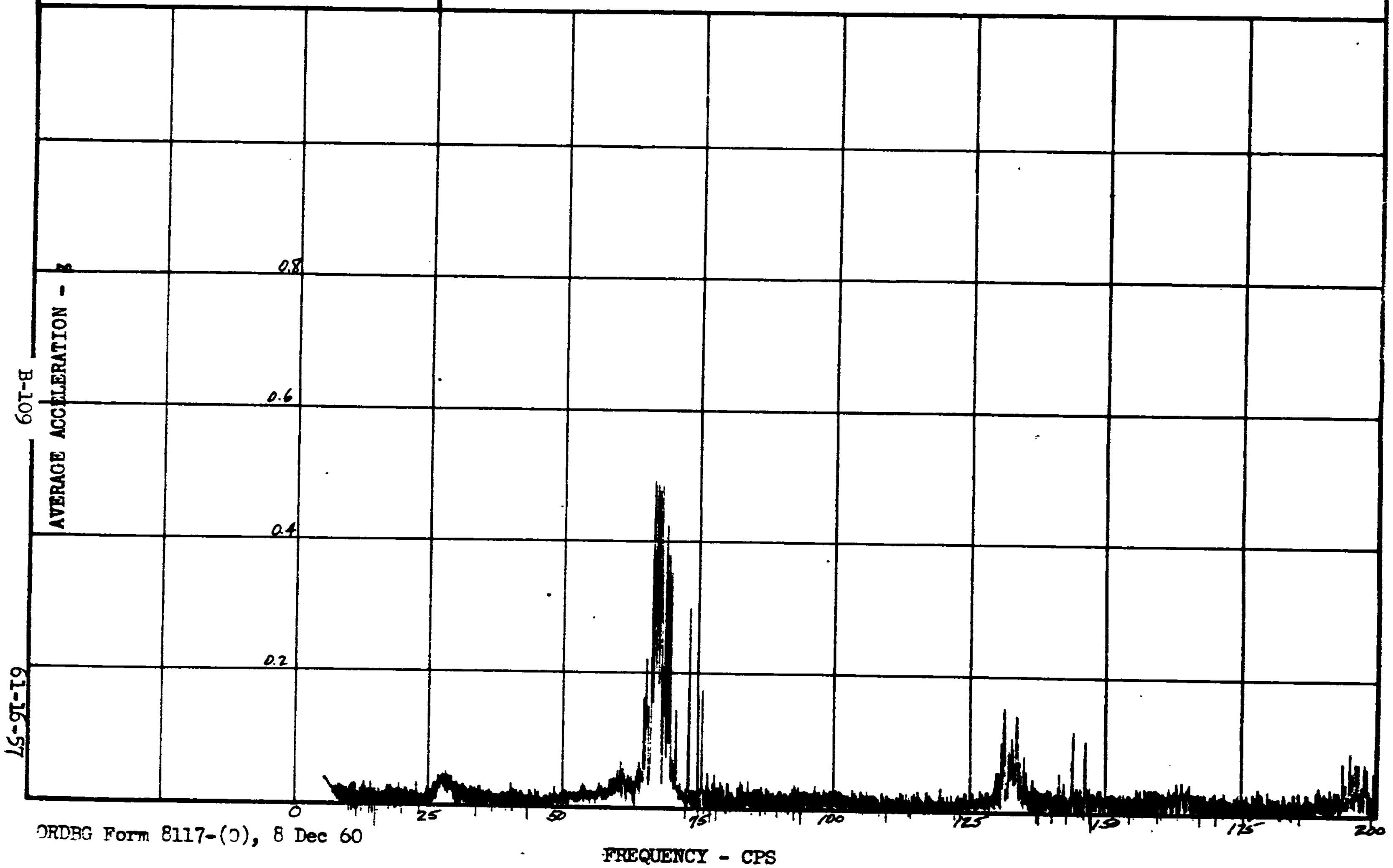
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 7 PLANE VERT LOCATION INSTRUMENT RACKS #4 & 5 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.



ORDBG Form 8117-(O), 8 Dec 60

61-16-56

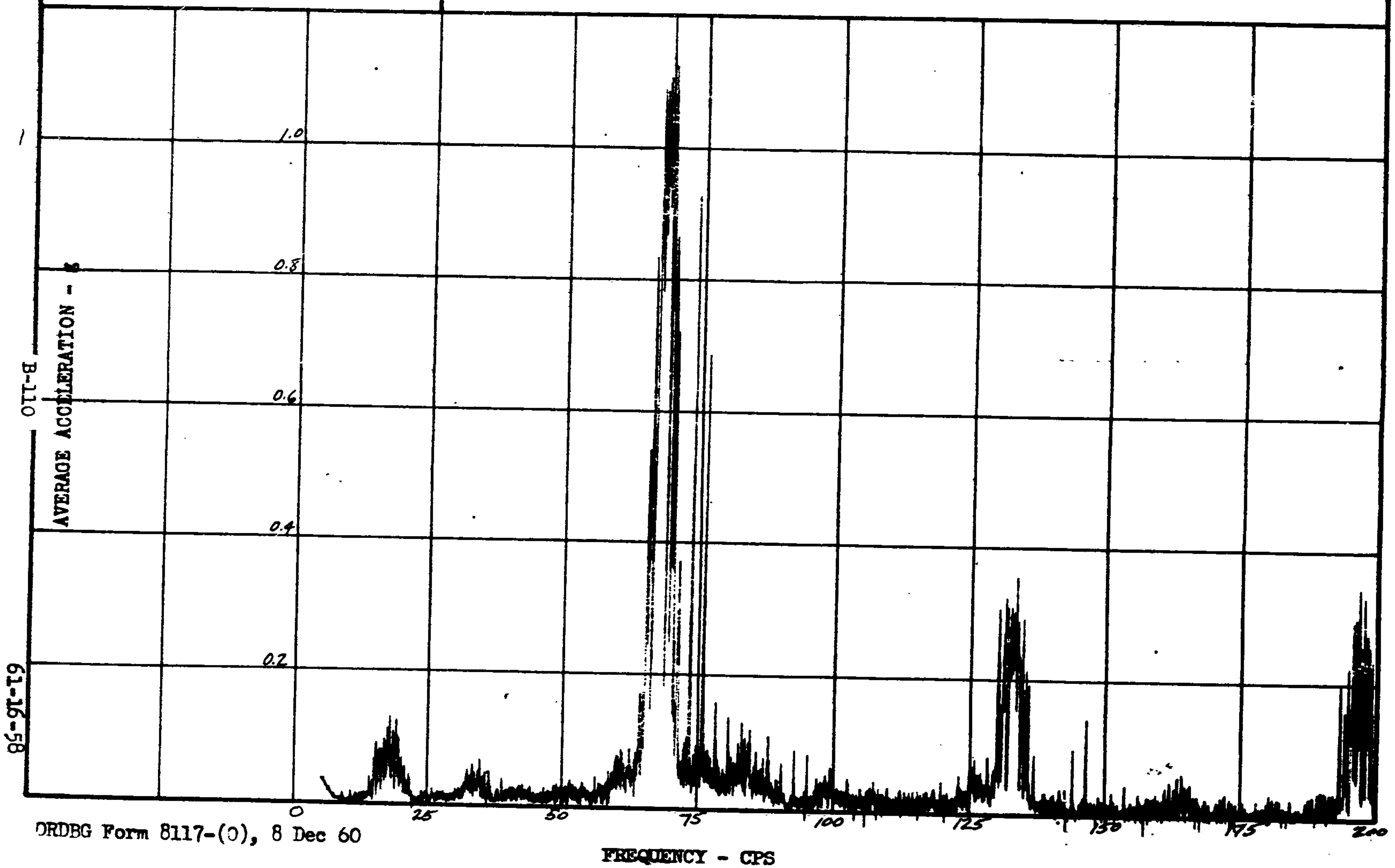
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 -- W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 8 PLANE TRANS. LOCATION INSTRAMENT RACKS #4 & #5 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.



ORDBG Form 8117-(O), 8 Dec 60

61-16-57

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 9 PLANE LONG. LOCATION INSTRUMENT PACKS #4 & #5 RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 4-1-61 SHEET NO. 1 of 2

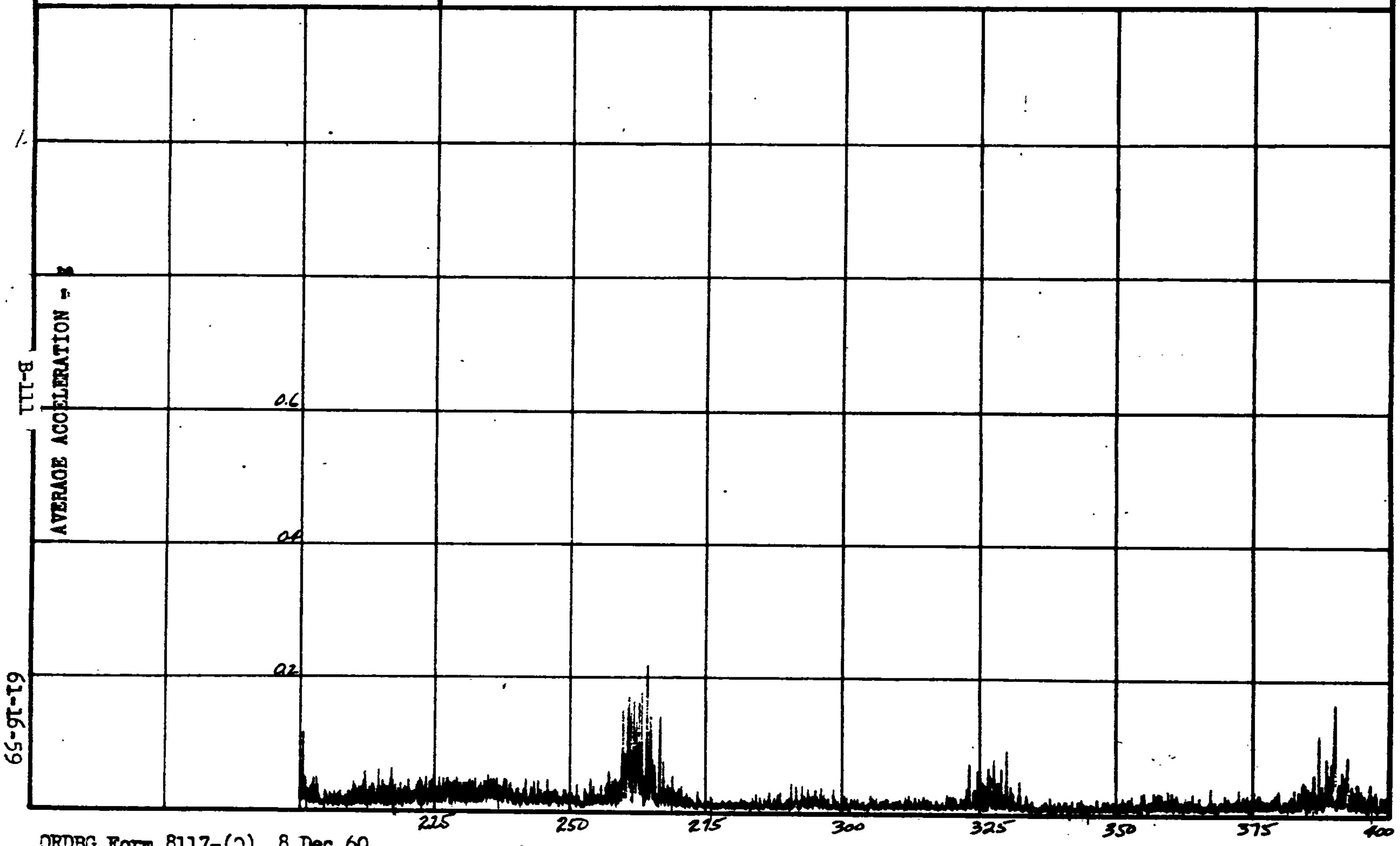


ORDBG Form 8117-(O), 8 Dec 60

61-16-58

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

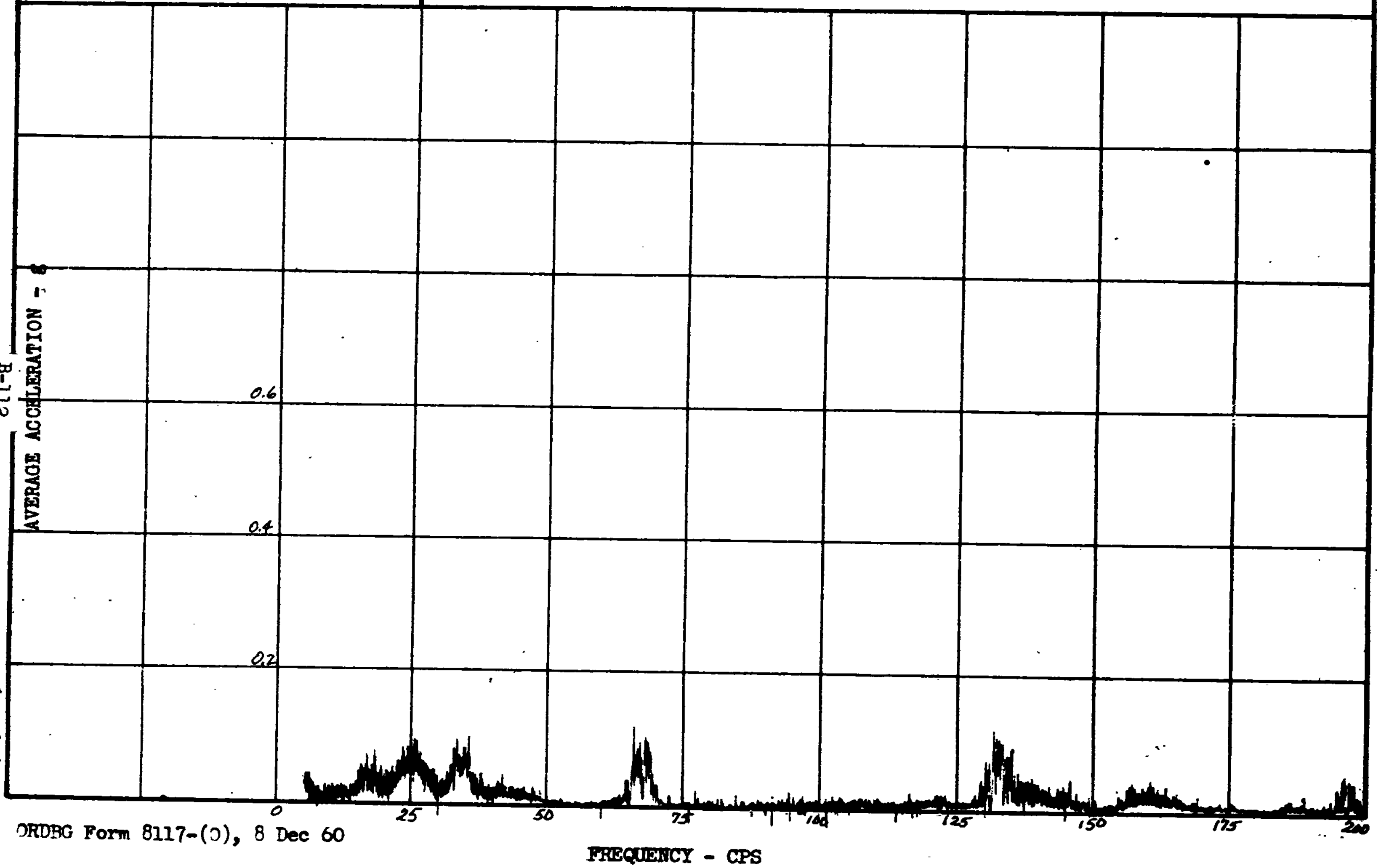
TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH
CHANNEL 9 PLANE LONG LOCATION INSTRUMENT RACKS #4 & #5
RECORD 201 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. 2 of 2



ORDBG Form 8117-(O), 8 Dec 60

61-16-59

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - WITH PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 10 PLANE VERT LOCATION KLYSTRON COAX LINE RECORD 201 SEC. EFF. FILTER BW 25 CPS. DATE OF TEST 14-1-61 SHEET NO. ____

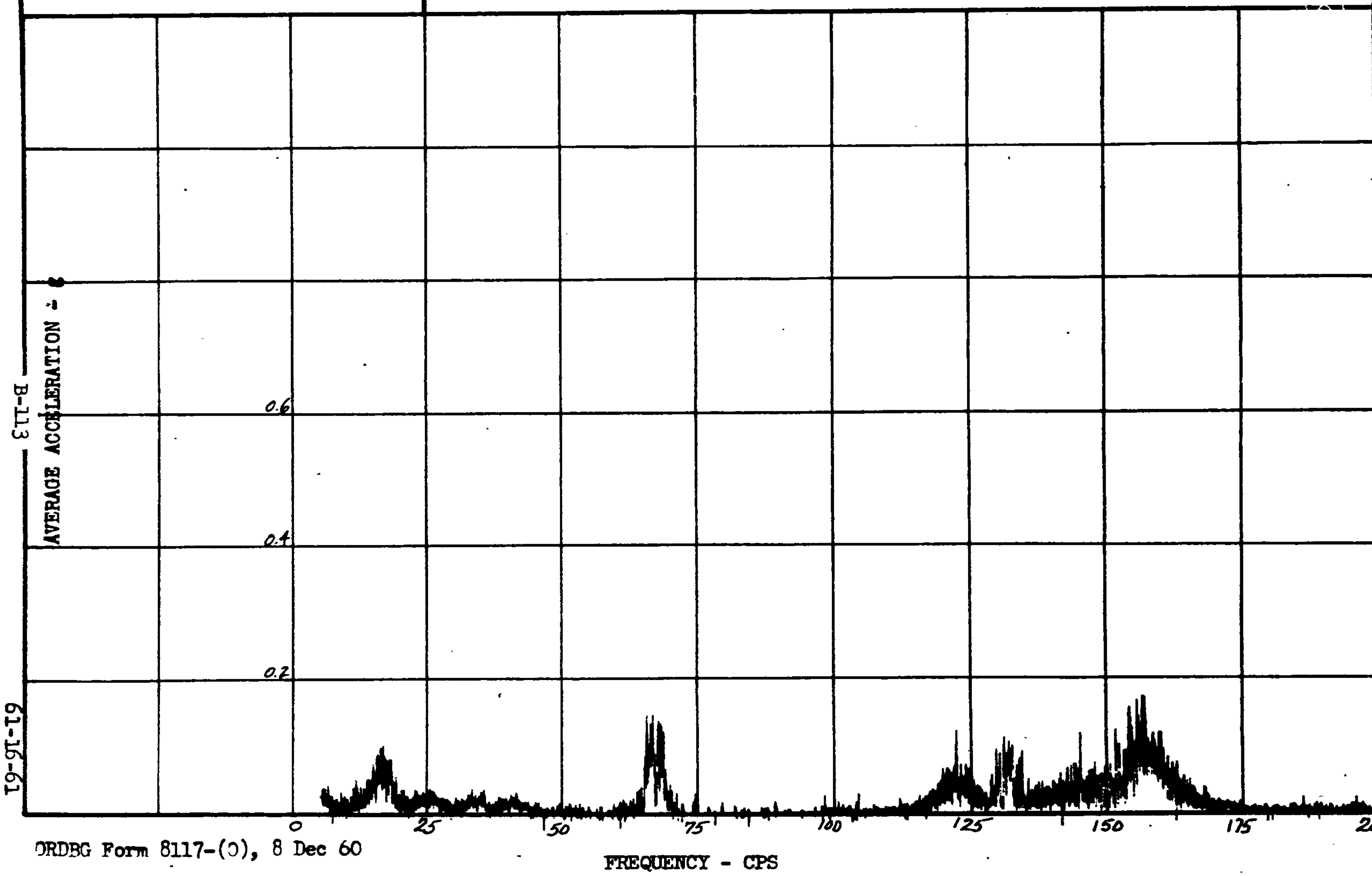


ORDBG Form 8117-(O), 8 Dec 60

B-112

61-16-60

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 - W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 11 PLANE TRANS. LOCATION KLYSTRON COAX LINE RECORD 20.1 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____

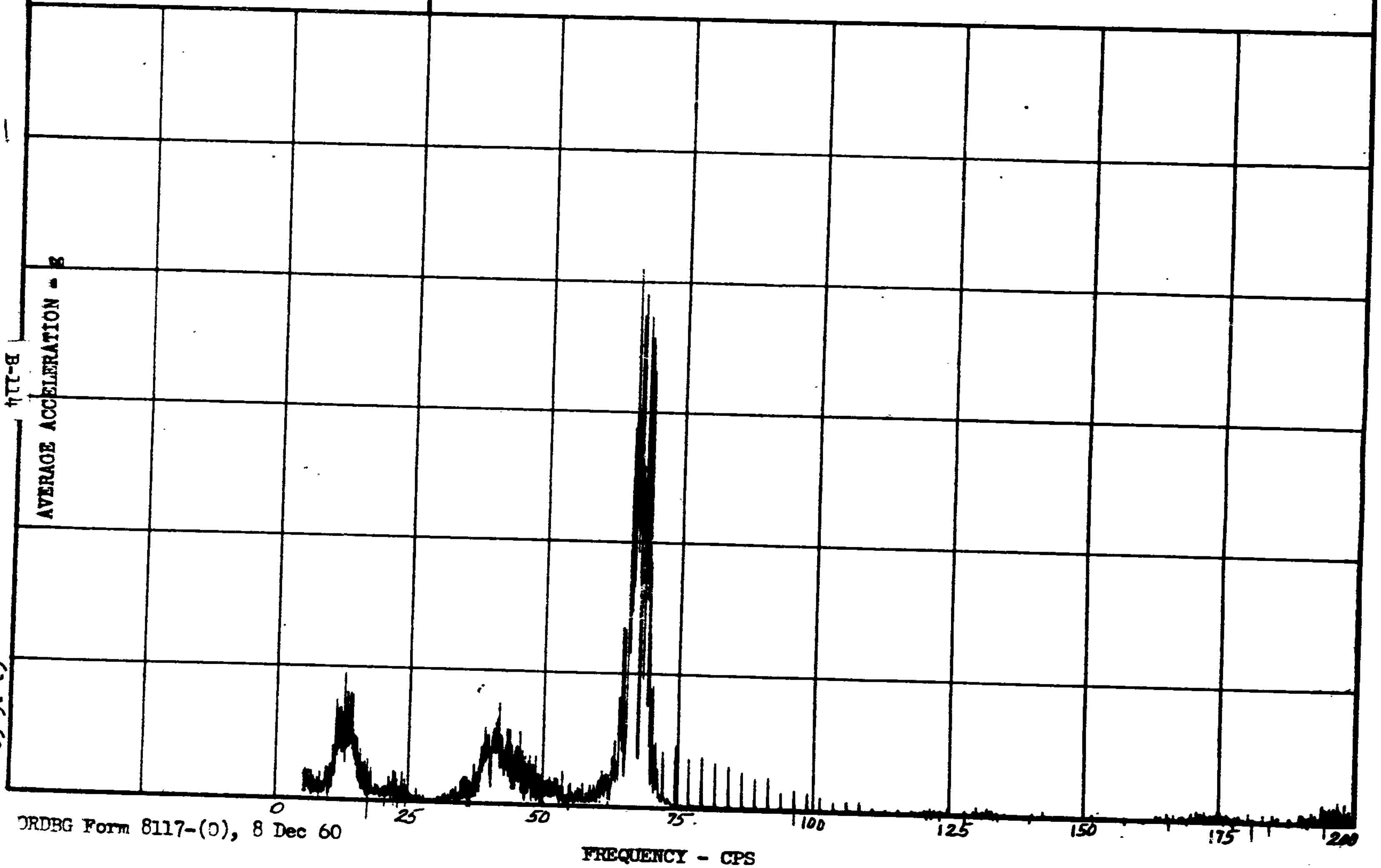


ORDBG Form 8117-(O), 8 Dec 60

61-16-61

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

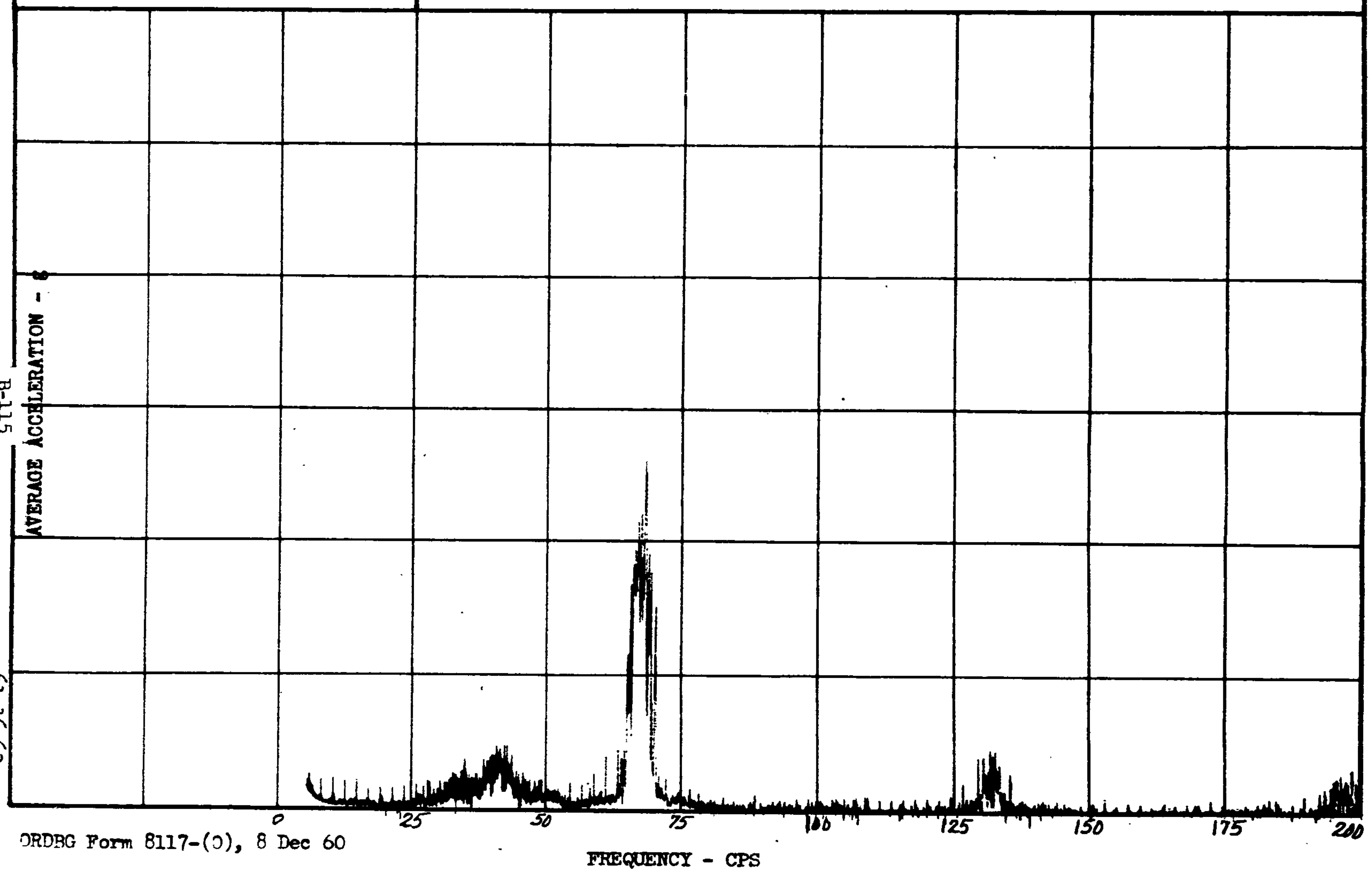
TEST OF XM474 - W/PERSHING Communication Pack COURSE Paved SPEED 22 MPH
CHANNEL 12 PLANE LONG LOCATION KLYSTRON COAX LINE
RECORD 201 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(D), 8 Dec 60

61-16-62

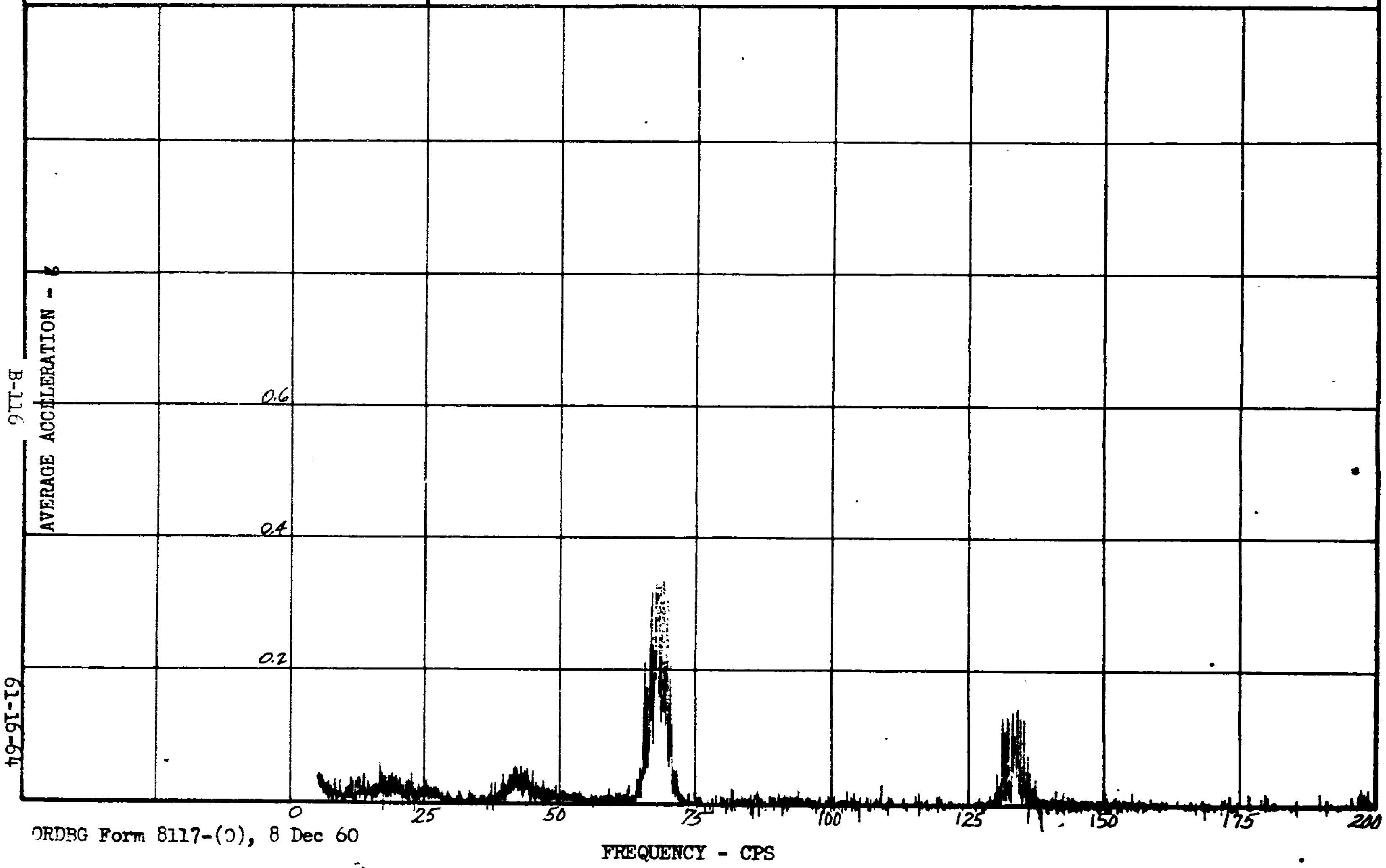
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 -- W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 13 PLANE VERT LOCATION INSTRUMENT RACKS #2 & #3 RECORD 20.0 SEC. EFF. FILTER BW 25 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(O), 8 Dec 60

61-16-63

AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474 -- W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 14 PLANE TRANS. LOCATION INSTRUMENT RACKS #2 & #3 RECORD 20.0 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO.

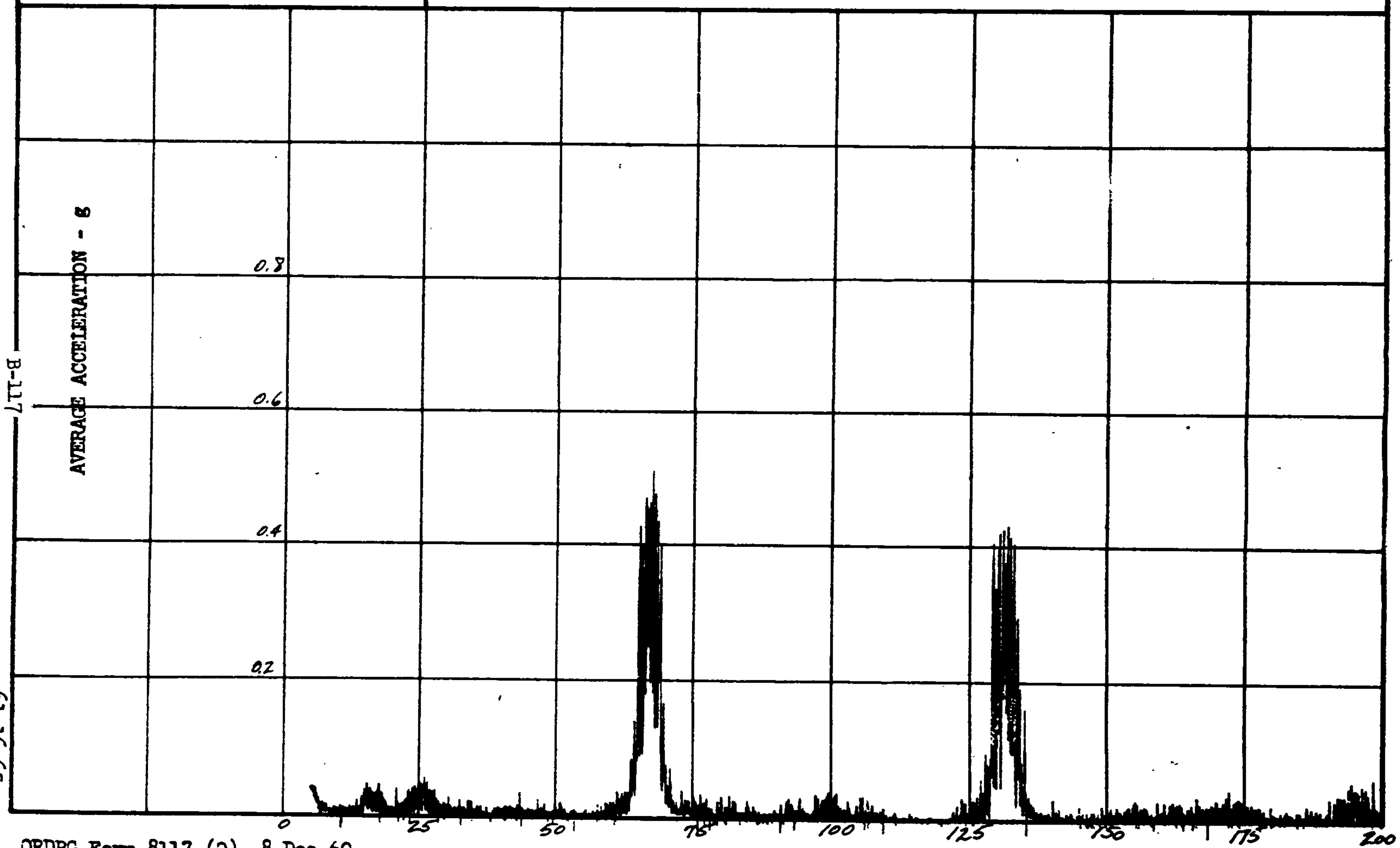


ORDBG Form 8117-(O), 8 Dec 60

61-16-64

AUTOMOTIVE ENGINEERING LABORATORY
DEVELOPMENT & PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

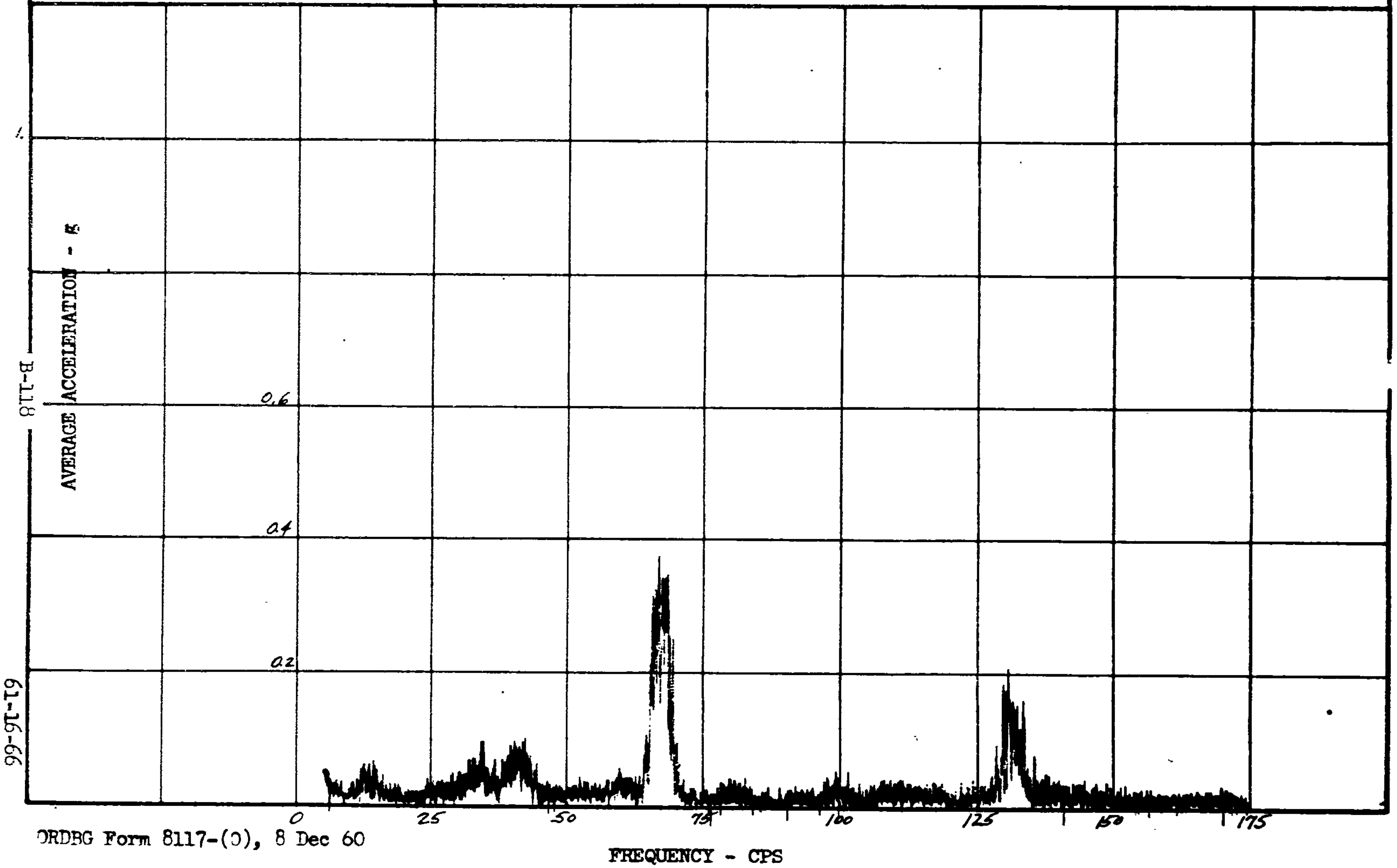
TEST OF XM454 - W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH
CHANNEL 15 PLANE LONG. LOCATION INSTRUMENT RACKS #2 & #3
RECORD 20.0 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(O), 8 Dec 60

61-16-65

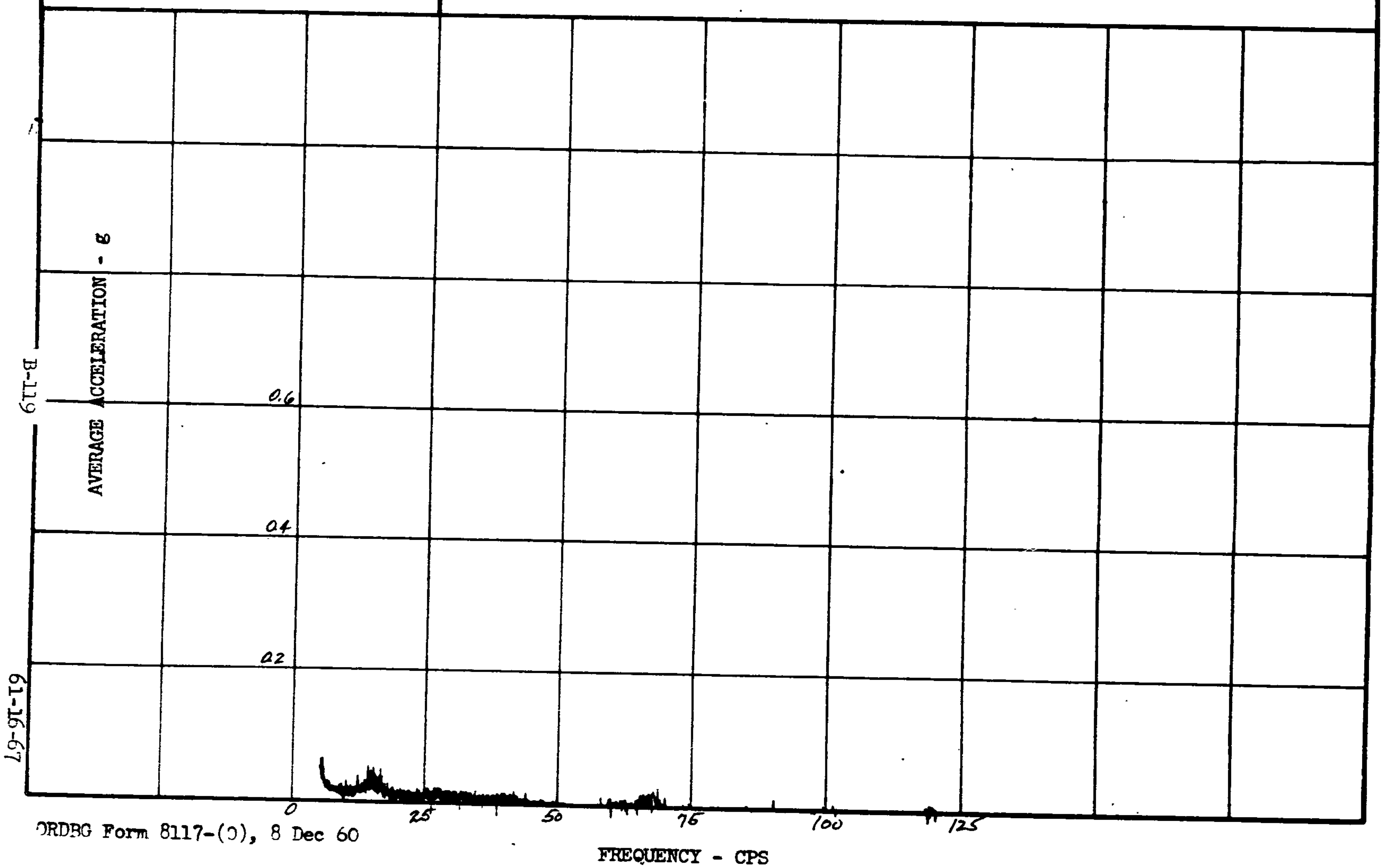
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474--W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 16 PLANE VERT LOCATION TELETYPE TABLE RECORD 20.0 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(O), 8 Dec 60

61-16-66

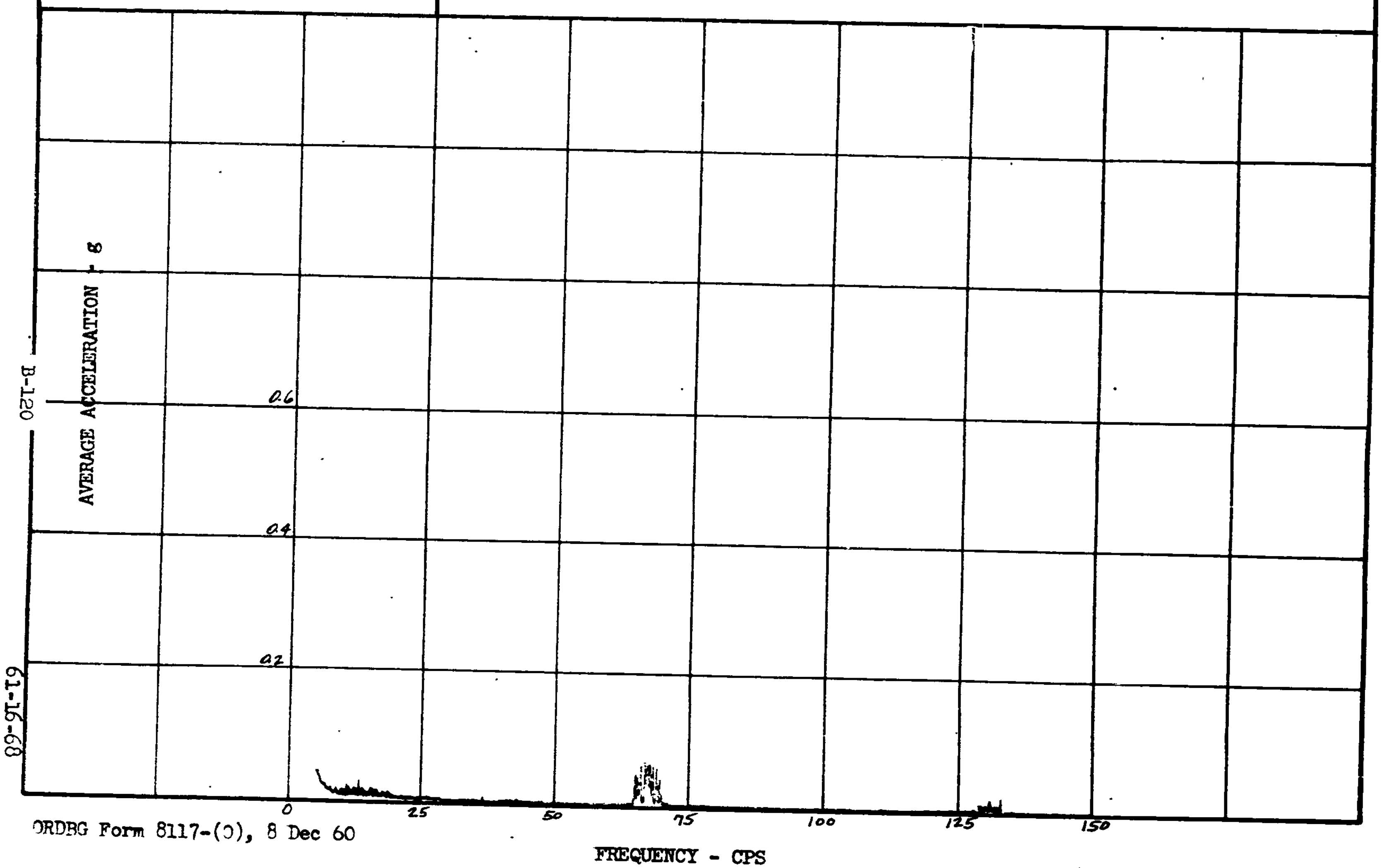
AUTOMOTIVE ENGINEERING LABORATORY DEVELOPMENT & PROOF SERVICES ABERDEEN PROVING GROUND, MARYLAND	TEST OF XM474--W/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH CHANNEL 17 PLANE VERT. LOCATION ENGINE-GENERATOR RECORD 20.0 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



ORDBG Form 8117-(0), 8 Dec 60

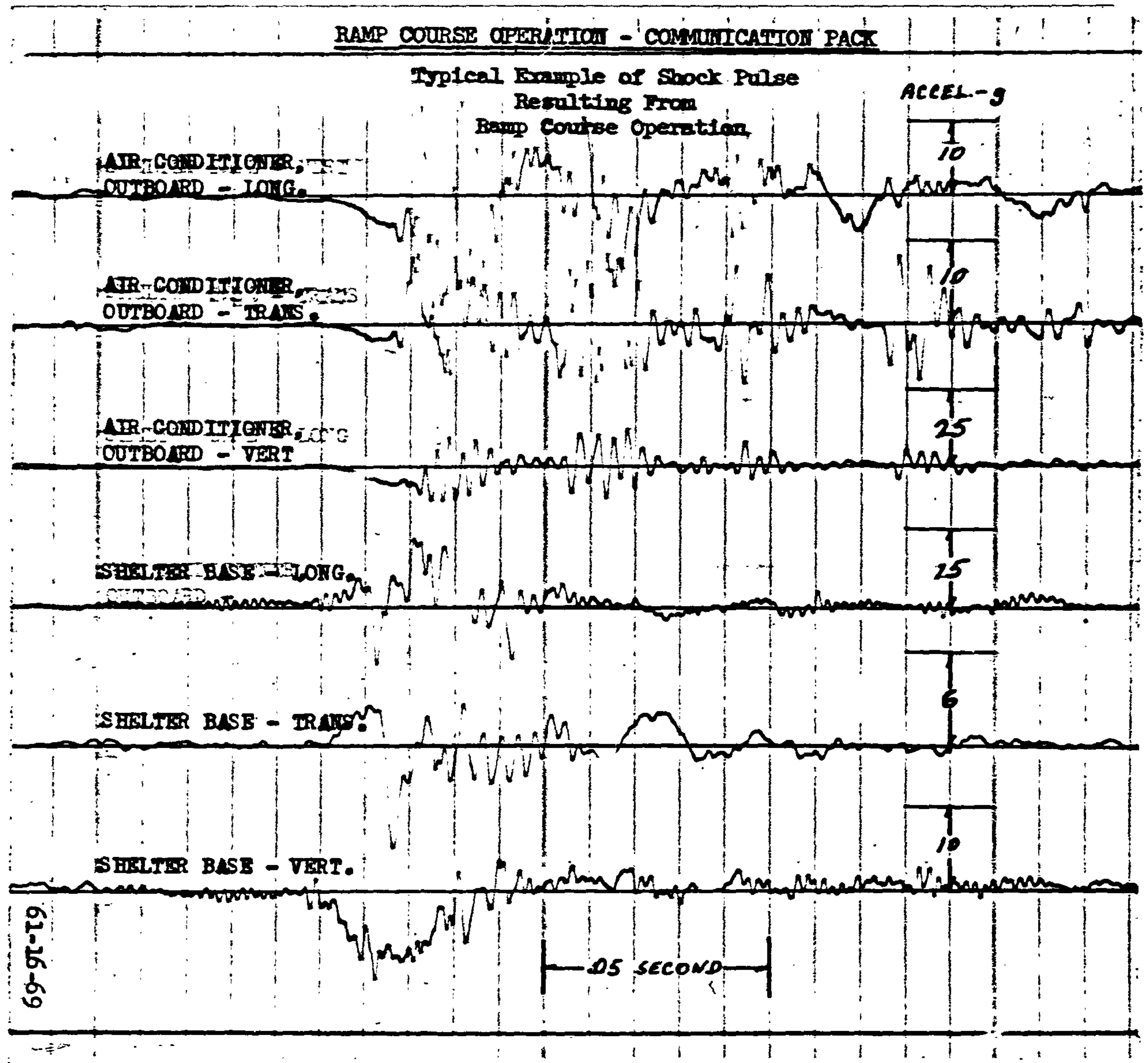
61-16-67

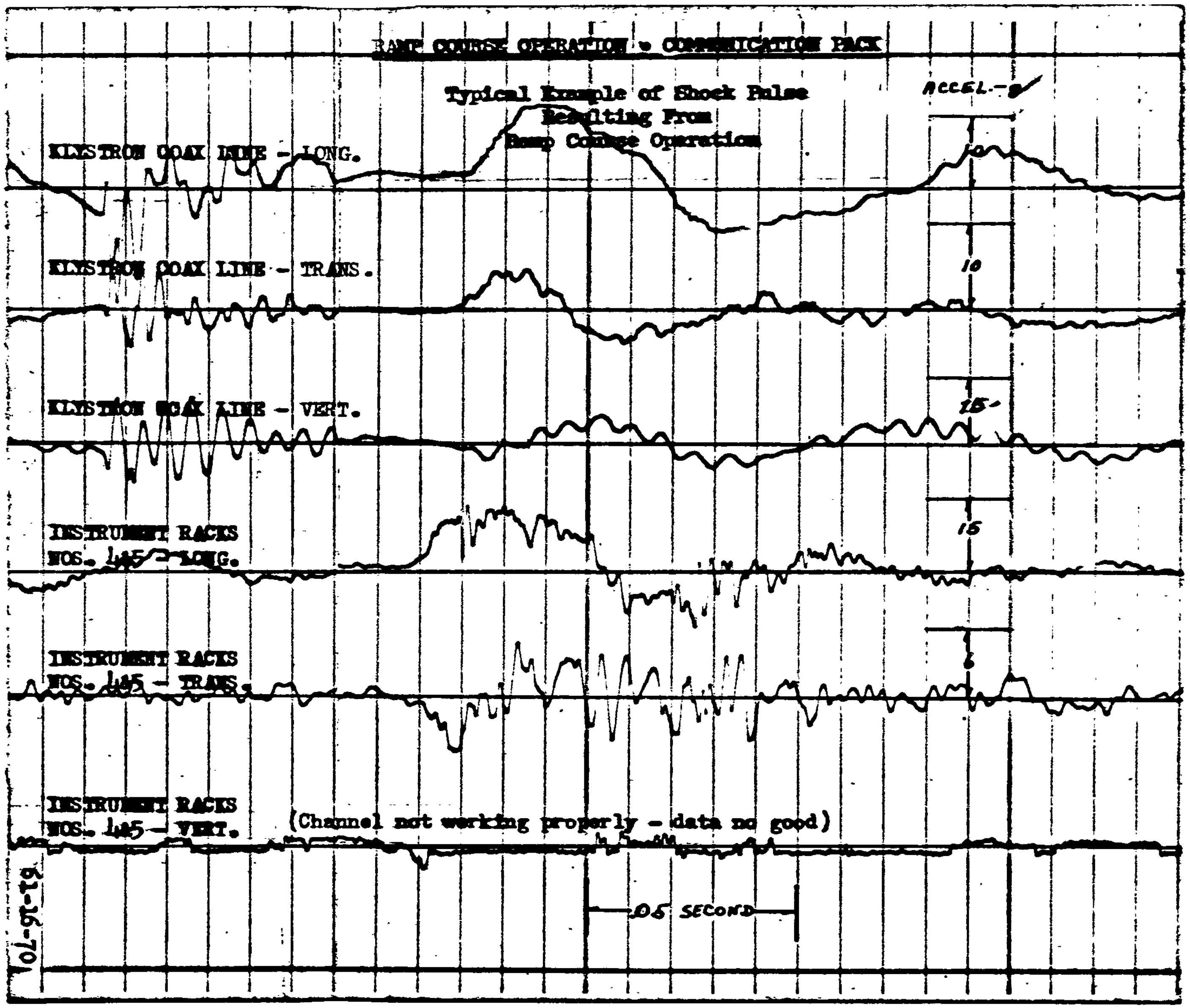
AUTOMOTIVE ENGINEERING LABORATORY	TEST OF XM474 -- w/PERSHING COMMUNICATION PACK COURSE PAVED SPEED 22 MPH
DEVELOPMENT & PROOF SERVICES	CHANNEL 18 PLANE LONG. LOCATION ENGINE-GENERATOR
ABERDEEN PROVING GROUND, MARYLAND	RECORD 20.0 SEC. EFF. FILTER BW 2.5 CPS. DATE OF TEST 14-1-61 SHEET NO. ____



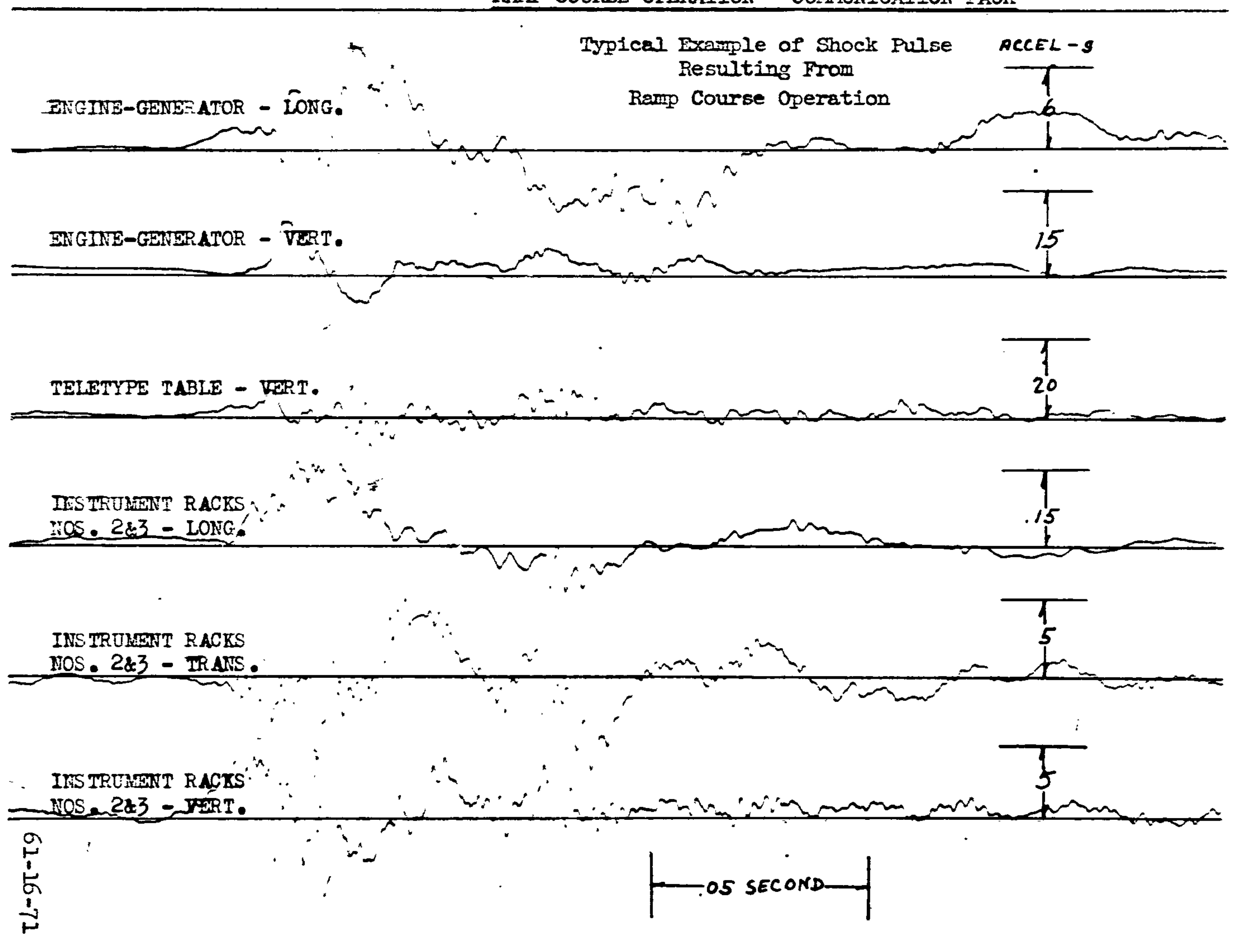
ORDBG Form 8117-(O), 8 Dec 60

61-16-68

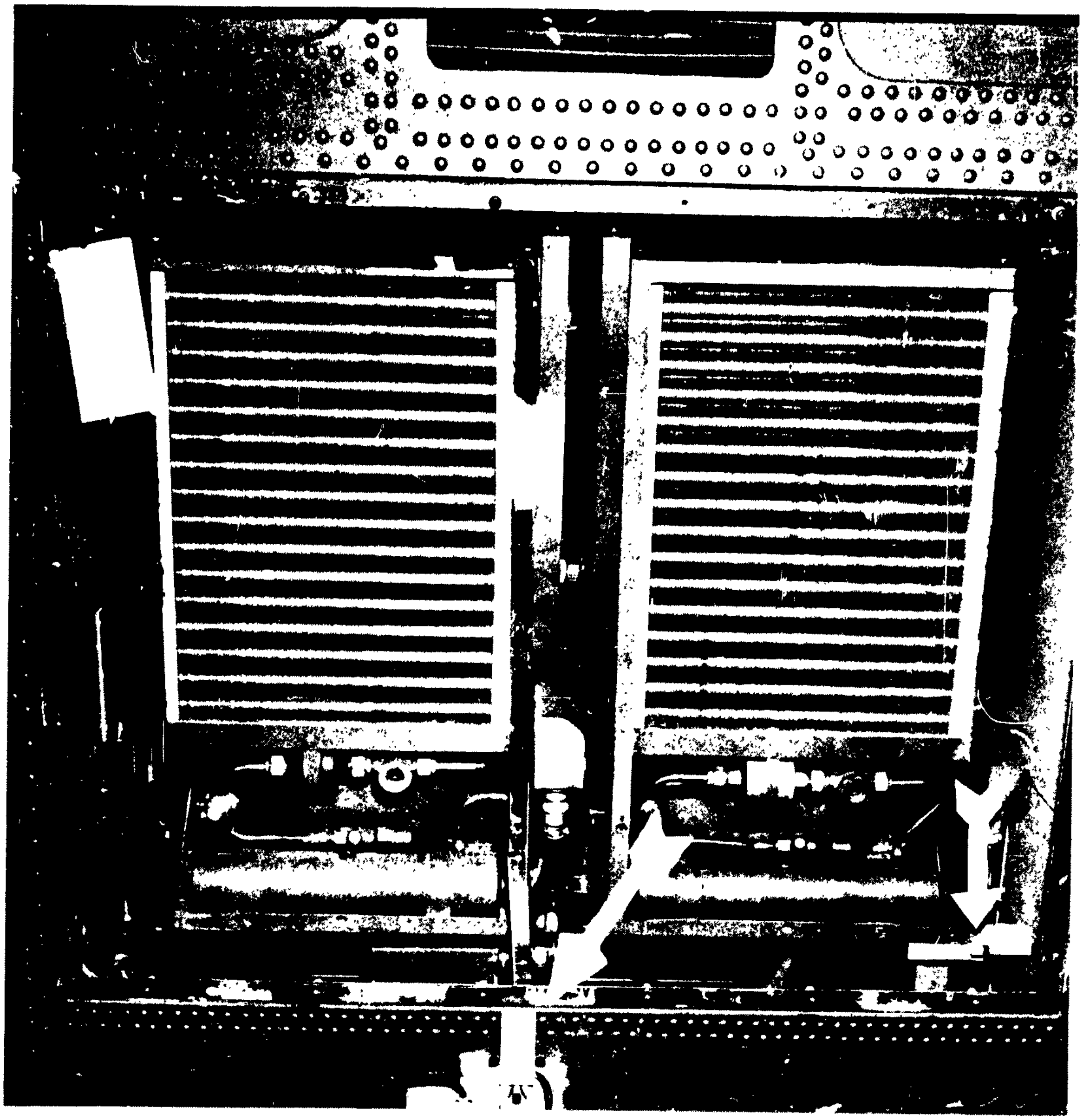

RAMP COURSE OPERATION - COMMUNICATION PACK
Typical Example of Shock Pulse
Resulting From
Ramp Course Operation
ACCEL.-g
10
10
25
25
6
10
AIR-CONDITIONER,
OUTBOARD - LONG.
AIR-CONDITIONER,
OUTBOARD - TRANS.
AIR-CONDITIONER,
OUTBOARD - VERT
SHELTER BASE - LONG.
SHELTER BASE - TRANS.
SHELTER BASE - VERT.
.05 SECOND
61-16-69


RAMP COURSE OPERATION - COMMUNICATION PACK
Typical Example of Shock Pulse
Resulting From
Ramp Course Operation
ACCEL-g
KLYSTRON COAX LINE - LONG.
10
KLYSTRON COAX LINE - TRANS.
10
KLYSTRON COAX LINE - VERT.
15
INSTRUMENT RACKS
NOS. 4&5 - LONG.
15
INSTRUMENT RACKS
NOS. 4&5 - TRANS.
6
INSTRUMENT RACKS
NOS. 4&5 - VERT.
(Channel not working properly - data no good)
.05 SECOND
61-16-70

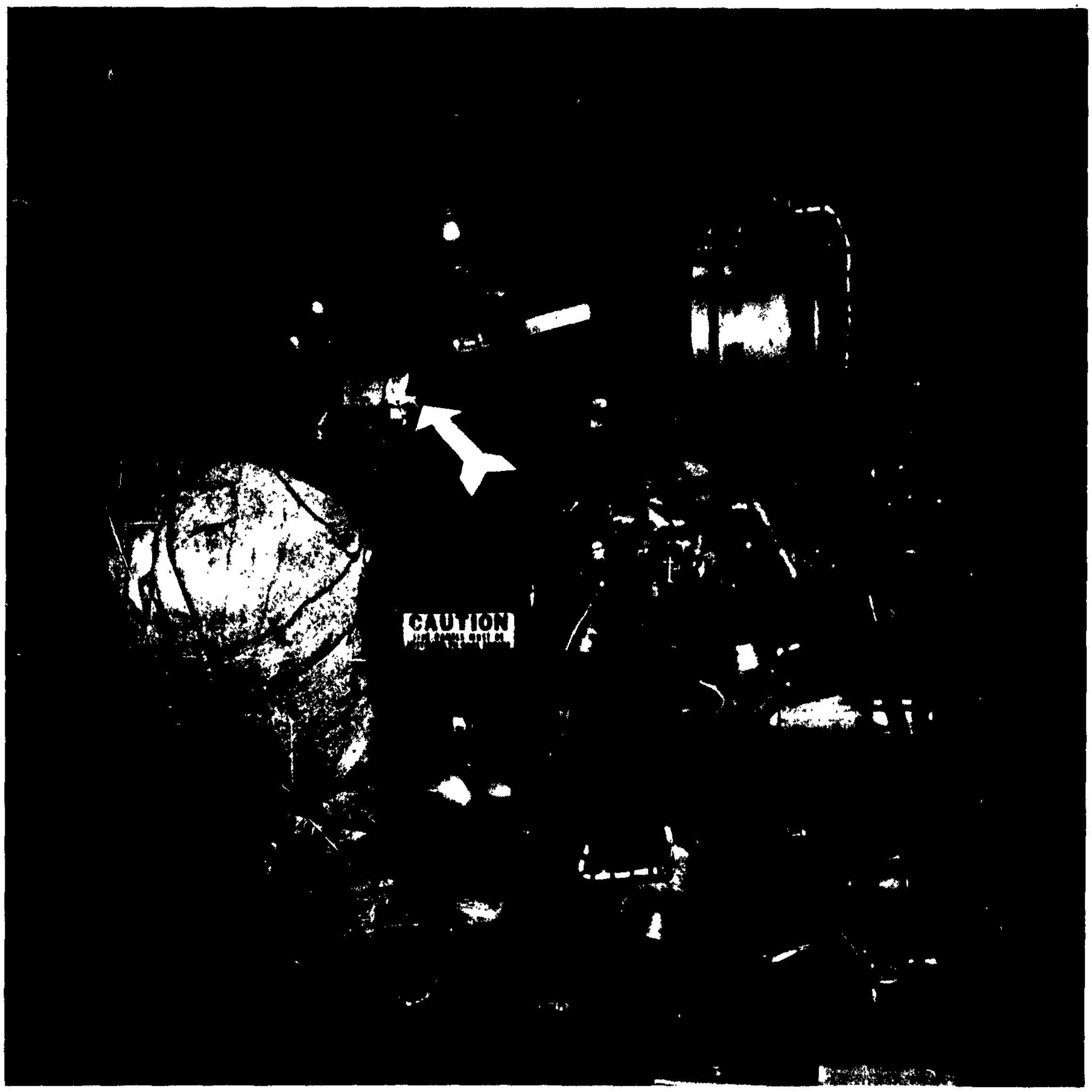
RAMP COURSE OPERATION - COMMUNICATION PACK



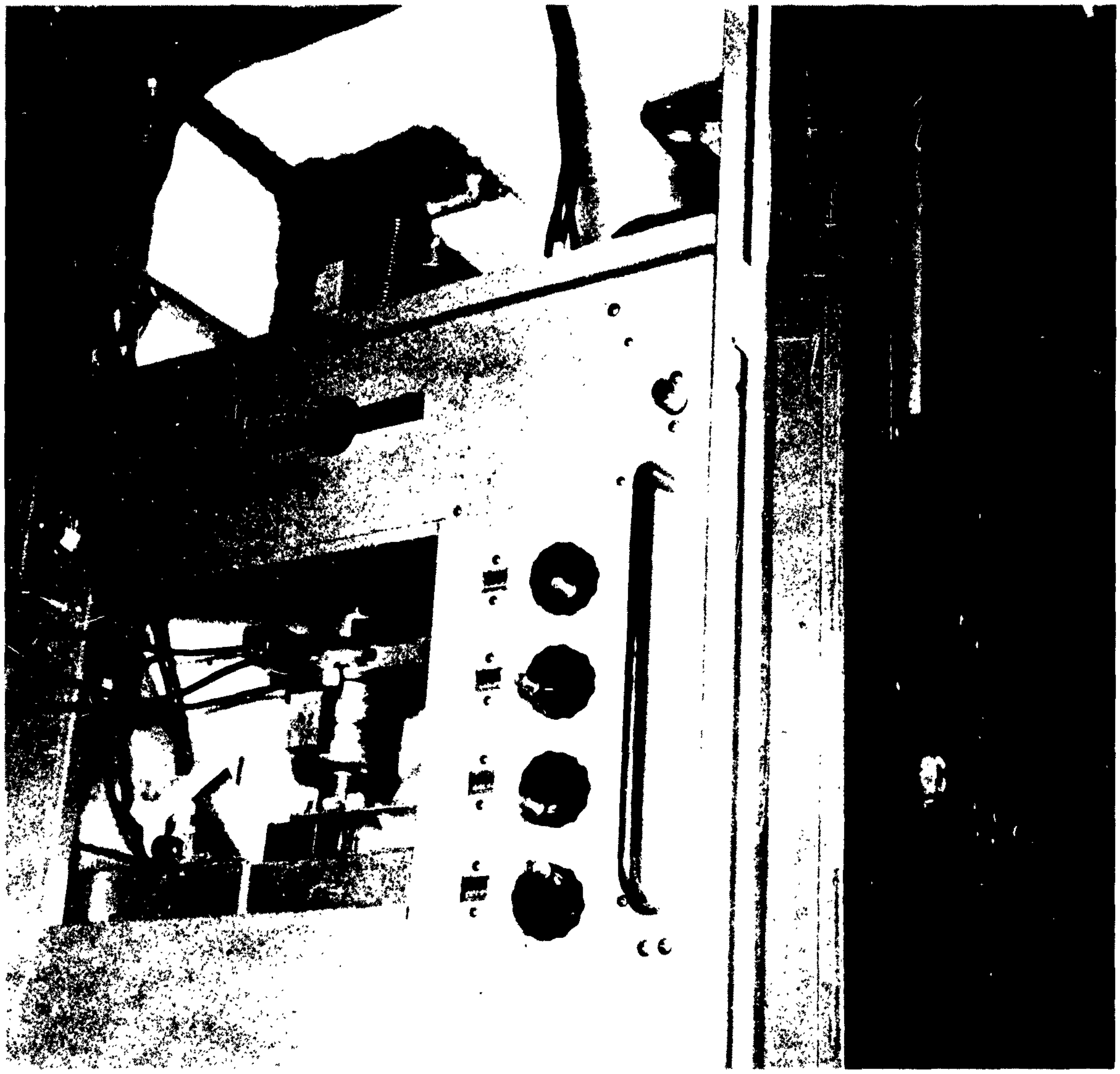
61-16-71



S18-001-146-1430-55-3T/ORD-61: Accelerometer Installation at Base of Shelter with Arrows Indicating Position of Instrumentation on Air Conditioners.

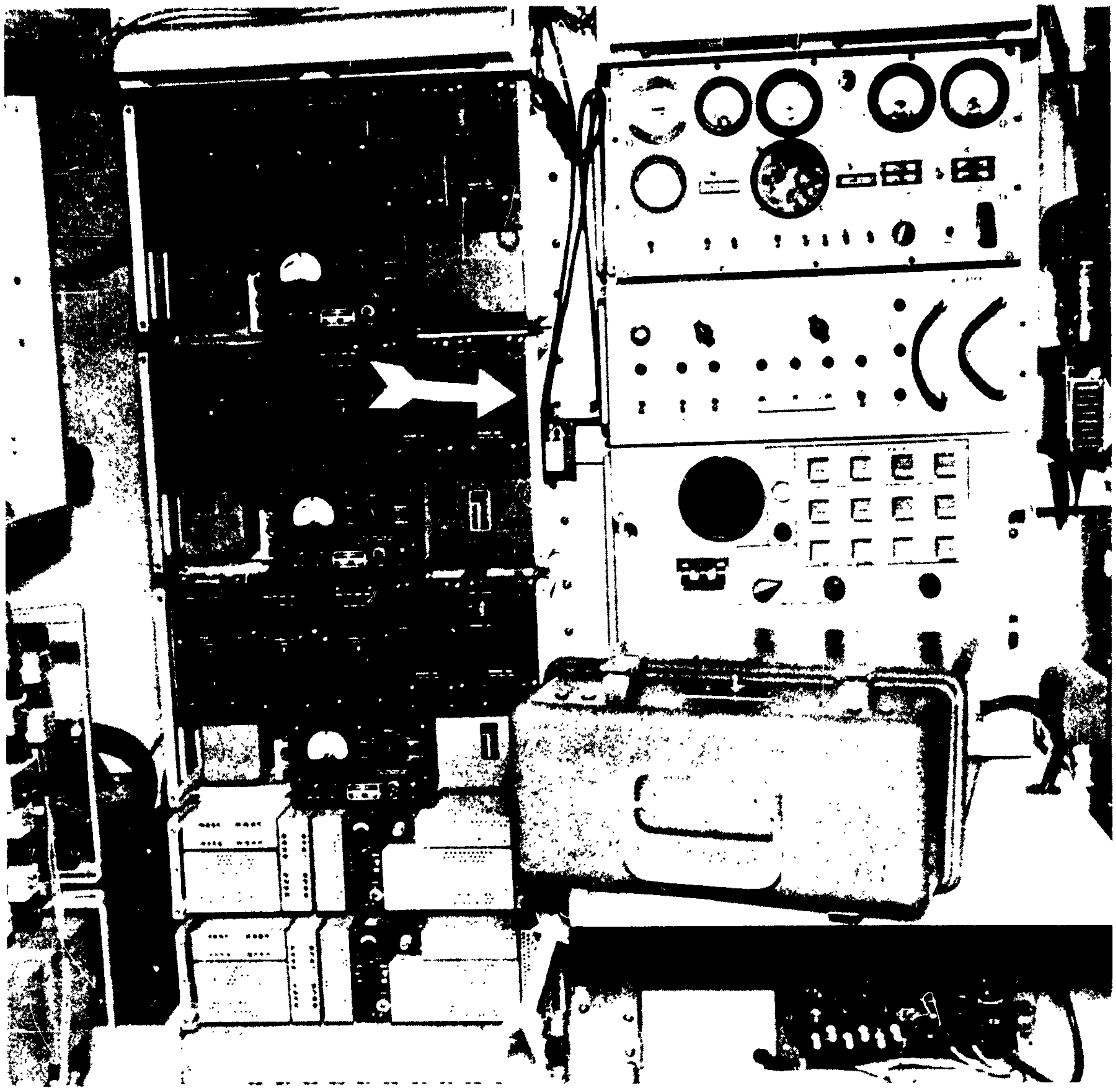


S18-001-147-1430-55-4T/ORD-61: Accelerometers Mounted on the Engine-Generator Unit.

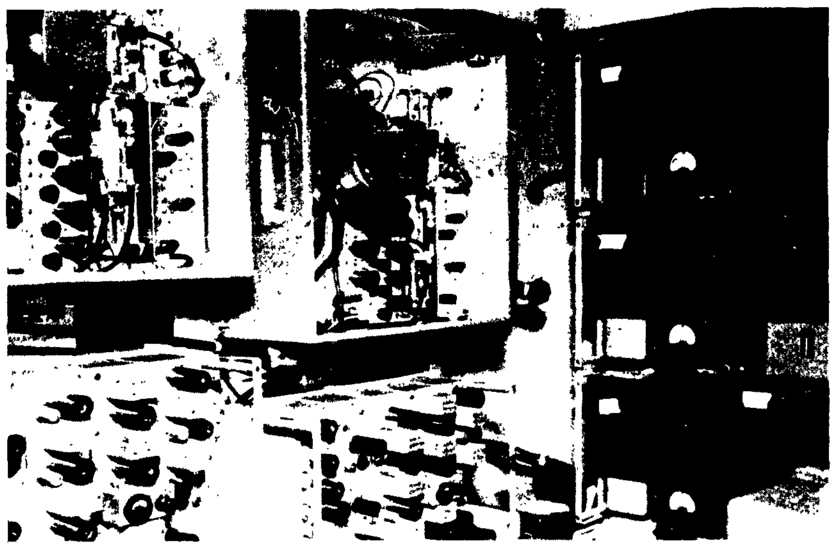


S18-001-148-1430-55-5T/ORD-61: Accelerometers Mounted on Klystron Coaxial Line.

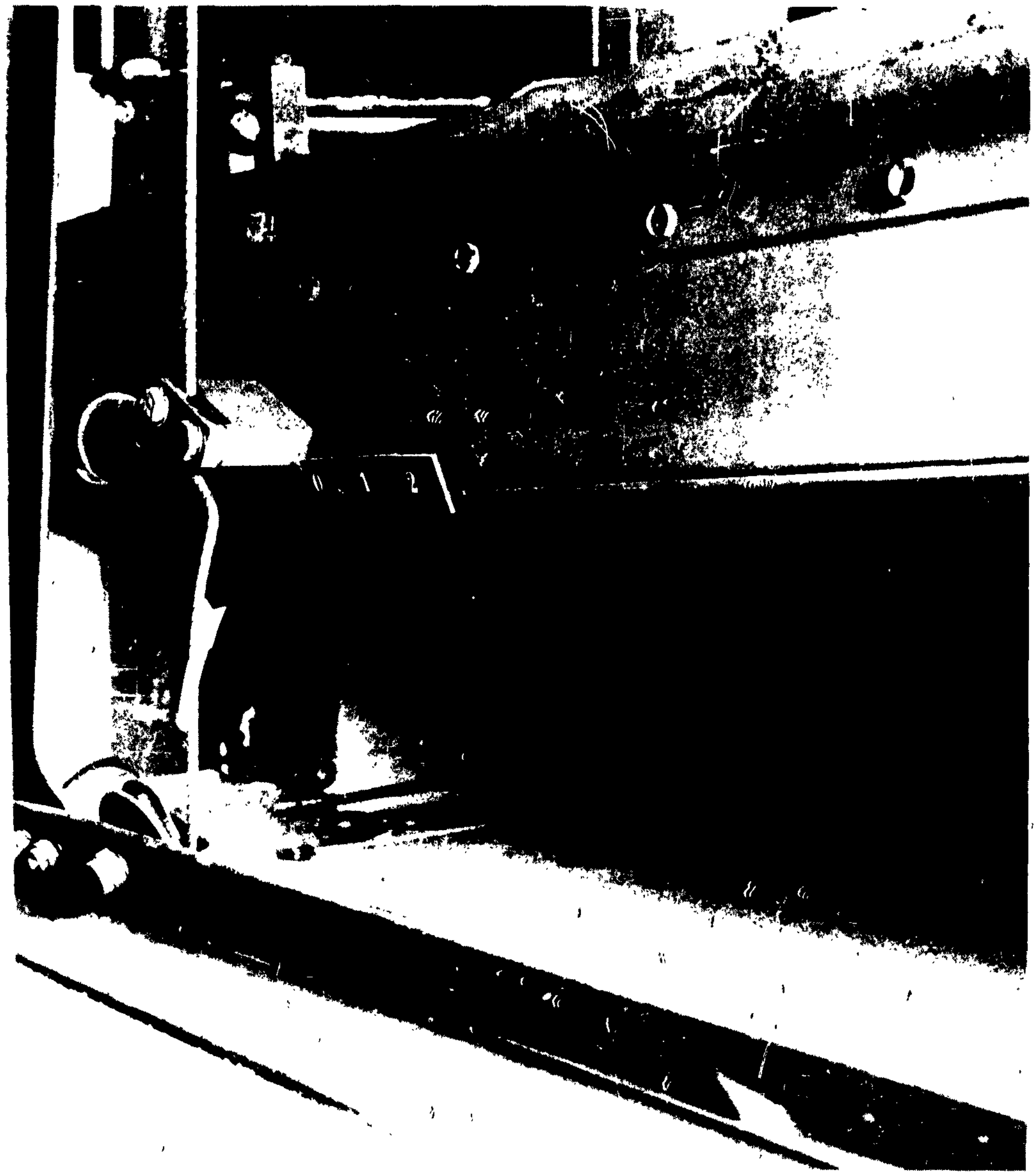
S18-001-149-1430-55-6T/ORD-61: Accelerometers Mounted on the Receiver Racks (Racks 4 and 5).



S18-001-150-1430-55-7T/ORD-61: Accelerometers Mounted between Synthesizer and Control Rack (Racks 2 and 3) and on Teletypewriter Table.



S18-001-161-1430-55-8T/ORD-61: Top: View of UHF Converter Showing Damaged Wiring as a Result of Vibration Testing. Unit Located in Rack No. 4. Bottom: Over-All View of Damaged Unit Positioned in Rack No. 4.



S18-001-186-1430-55-9T/ORD-61: View through Door Showing Damaged Cable Pulleys in Antenna Storage Area.

ENGINEERING LABORATORIES
PHYSICAL TEST LABORATORY REPORT

ORDBG-DPS-LP

TEST OF:	Report No. 61-T-2
Vibration Test of Pershing AN/TRC-80 Communications Pack.	Sheet 1 of 6
	Dates of Test 14 Nov 60 to 6 Jan 61
OBJECT OF TEST:	Conducted for Mr. R. Wiles,
To subject the Communications Pack to low level vibrations and record any component resonances.	Automotive Laboratory
	Project No. 0.127X2/160
	B. A. No. 337-030-01
	Reference None

INTRODUCTION:

1. At the request of the Pershing Communications Pack Test Committee, the Physical Test Laboratory performed vibration tests on one AN/TRC-80 Pershing Communications Pack.

2. The purpose of the tests was to subject the Communications Pack to vibrations in the frequency range of 15 to 500 cps along each of three major axes. At a test environment of ambient temperature, the vibration test was to precede a fully instrumented road test and its main objective was a resonance search and not a proof test. The input levels were to be kept at a low level in order not to damage components of the Communications Pack. Component resonances and magnitudes were to be noted and minor modifications in order to attenuate resonances were to be made. Decisions concerning vibration input level and modifications were to be made by agreement between Physical Test Lab, Fort Huachuca personnel and Collins Radio Company personnel who were acting as "on the spot" representatives of other component manufactures. Other interested parties, such as The Martin Co., ABMA, ERDL and Teleprinter Corp were notified about progress and developments.

3. At the conclusion of testing recommendations were to be made to Automotive Test Group concerning vibration pickup locations to be used during the road test.

DESCRIPTION OF MATERIEL:

1. The test specimen was one (1) AN/TRC-80 Pershing Communications Pack, Serial No. 1. The pack was a self contained communications terminal 100X80X66 inches in size and weighing approximately 4100 pounds.

2. The Communications Pack was composed of four major compartments, i.e., antenna compartment, air conditioning compartment, engine-generator compartment, personnel-instrumentation compartment, as shown in Figure 1, Appendix I.

3. In order to view as many components as possible, several access doors were removed prior to vibration testing. These were the engine-generator door, personnel-instrumentation door and a panel covering the air conditioning compartment.

4. The test request called for the fuel tank to be filled half full with gasoline. Instead a solution of $2\frac{1}{2}$ gallons alcohol and $4\frac{1}{2}$ gallons water, which approximated the specific gravity of gasoline, was poured in the fuel tank prior to the vibration test.

INSTRUMENTATION:

1. The original locations of the accelerometers were determined by other than this facility. Twelve accelerometers were installed in inaccessible locations on the engine-generator during assembly of the pack by The Martin Company. The remaining accelerometers were installed by Aberdeen Proving Ground personnel.

2. The accelerometers were screwed into one inch cube magnesium blocks which were attached to the pack components with dental cement. The blocks had at least three faces drilled and tapped to match the threaded stud on the accelerometers. The blocks that were inaccessible after the pack was assembled had three accelerometers mounted, i.e., one along each major axes, while the accessible blocks generally had one accelerometer which was rotated to measure accelerations along each axis as required. Appendix I contains a detailed description of the location of each accelerometer as well as sketches indicating their approximate locations.

3. The recording instrumentation as originally setup consisted of 40 channels capable of linear response over a frequency range of 15 to 500 cps. The recording instruments consisted of 18 channels on a type 1012 direct writing visicorder, 12 channels on a type 114 CEC Datarite Oscillograph and 10 channels on a FR-100A Ampex Tape Recorder. Several test runs were made using the full 40 channel recording system. But for several reasons, mainly for ease of monitoring and to lower the frequency response to 5 cps, all recording was made on the visicorder for the majority of the test runs. The system was made up of 20 CRL cathode follower-amplifiers and the type 1012 visicorder. Each of the 20 channels was calibrated by applying a variable voltage source in place of the accelerometer and recording the galvanometer trace deflection. The sensitivity for each channel was calculated and used to determine an overall response for each galvanometer - accelerometer combination. The sensitivity of each accelerometer was previously determined by calibration on an MB-C10 calibrator.

TEST PROCEDURE AND RESULTS:

1. Vibration along vertical axis.

a. The Communications Pack was initially setup for vibration along the vertical axis. A massive welded aluminum fixture, bolted to the table of a MB C-210 exciter, was used as a test platform for the Communications Pack. The aluminum fixture was designed to have no major resonances in the frequency range of 5 to 500 cps by analysis as a two degrees of freedom vibration system. Only the skids of the Communication Pack contacted the aluminum fixture. Four 5/8 inch threaded holes and four ½ inch studs in the pack were utilized to attach the pack to the fixture. Four coil springs, with spring rates of 700 lbs. per inch each, were used to support the test setup. A sketch of the test setup is shown in Figure 1 and a photograph is included as Figure 2, Appendix II.

b. The test procedure called for frequency sweeps from 15 to 500 cps at low input levels. The test runs were accomplished by locking the vibration exciter at a constant acceleration level and sweeping the frequency range. A total of 5 runs were made with the input acceleration level ranging from .25 to .75 g. During the test runs the outputs of the accelerometers were monitored and any resonant frequencies present were noted. Two of the runs at 3/4 g input level were permanently recorded over the entire frequency range for use in accurately measuring g levels and frequencies.

c. The results of the test runs indicated that accelerometers numbers 10 and 11 yielded the only significant outputs. These accelerometers were located on the rigid section of the Klystron tube transmission line as shown in Figure 3, Appendix II. With an input of .75 g, accelerometer number 10, measuring along the vertical axis indicated a peak acceleration of .81 g. Accelerometer number 11 indicated a peak acceleration of .55 g. Both peak accelerations occurred at a frequency of 30 cps. On a subsequent test run the Klystron tube transmission line was revised as shown in Figure 3. With an input of .75 g accelerometers numbers 10 and 11 indicated .02 g and .01 g respectively.

d. The test results for the vertical vibration tests are included in Table I, Appendix III. The tabular results present the exciter input level, accelerometer levels, resonant frequencies and magnification ratios only for accelerometers which indicated significant g values.

2. Vibration along lateral axis.

a. The Communications Pack was mounted on a welded aluminum fixture which was designed to support the pack during the horizontal vibration tests. The aluminum fixture consisted of a horizontal frame with an upright reinforced

plate at one end. The pack was installed in the fixture so the one end was contacting the fixture upright and the pack skids were bearing on the horizontal frame. Four coil springs were used to suspend the fixture and pack and the test fixture was attached to an MB C-210 exciter so vibrations were applied through the CG of the pack and test fixture combination. A sketch and photograph of the test setup are presented in Figures 4 and 5, Appendix II.

b. The pack was subjected to vibration test runs over a frequency range of 10 to 500 cps with input levels ranging from .25 g to 1.0 g. The input level was measured by the accelerometer in the exciter and also by accelerometer No. LA-1 mounted on the pack as shown in Figure 4, Appendix II. The accelerometer on the pack indicated within 10 percent of the accelerometer in the exciter over the test frequency range. A total of 10 test runs were made over the 10 to 500 cps frequency range and 6 test runs were made over a smaller frequency range. A test run consisted of locking the exciter input acceleration at a constant g level and varying the frequency over the test range. During the test runs the outputs of the accelerometers were monitored and any resonant frequencies present were noted. Two of the test runs at .75 g and 1.0 g input levels were permanently recorded over the entire frequency range for use in accurately measuring g levels and frequencies.

c. The results of the test runs show that accelorometers numbers 10 and 11 yielded significant outputs when the Klystron tube transmission Line was arranged in its original order. The peak accelerations for accelerometers numbers 10 and 11 were .45 g and .36 g respectively, with an input acceleration of .75 g. Both accelerometers peaked at 25 cps. With an input acceleration of 1.0 g and the Klystron tube transmission line revised as shown in Figure 3, no significant accelerations were noted on accelerometers 10 and 11. The accelerometer indicating the maximum acceleration was number 30. This accelerometer indicated .99 g with an input of 1.0 g at a frequency of 10 cps. Accelerometers numbers 29, 31 and 32 which along with number 30 were located on the engine-generator unit also indicated maximum accelerations at 10 cps.

d. Table II, Appendix III presents the pertinent test results for the lateral test runs.

3. Vibration along longitudinal axis.

a. The longitudinal axis vibration test setup was essentially the same as described for vibration along the lateral axis, except the pack was rotated 90° horizontally. Since the pack was only 80 inches wide along the longitudinal axis the upright reinforced fixture plate was 10 inches away from the side of the pack when a balanced setup was made. In order to reinforce the upright another gusseted plate was installed. A sketch and photograph of the test setup are presented in Figures 6 and 7, Appendix II.

b. The pack was subjected to vibration test runs over the frequency range of 5 to 500 cps with input levels ranging from .25 g to .75 g. The input level was measured by the accelerometer in the C-210 exciter. Accelerometer No. LO-1 mounted on the pack as shown in Figure 6, Appendix II, monitored accelerations which could also be used as the input level. A total of 6 test runs were made over a frequency range of 8 - 500 cps, two were made over a frequency range of 8 to 50 cps and two runs were made over a frequency range of 5 to 8 cps. A test run consisted of locking the exciter input acceleration at a constant g level and varying the frequency over the test range. During each of the test runs the outputs of the accelerometers were monitored and any resonant frequencies present were noted. Two test runs at constant input levels of .75 g were permanently recorded over a frequency range of 8 to 500 cps for use in accurately measuring g levels and frequencies.

c. The results of the test runs show that accelerometers numbers 10, 11, 29, 30, 36, 37 and 38 indicated significant accelerations when the accelerometer in the exciter was reading .75 g. Accelerometers 10 and 11 showed maximum outputs of .38 g and .41 g respectively, at 20 cps. These accelerometers were on the Klystron tube transmission line which was in its original condition as shown in Figure 3, Appendix II. Accelerometers 29 and 30, located on the engine-generator unit, indicated .49 g and .53 g respectively, at 10 cps. Accelerometers numbers 36, 37 and 38, located on the air conditioner condensor, indicated .53 g, 1.5 g and 1.2 g respectively, at 8 cps. The recorded trace of these accelerometers appeared to be a shock pulse at the rate of 8 pulses per second. Based on observation an internal component in the compressor housing appeared to be producing the shock.

d. Table III, Appendix III presents detailed test results for the longitudinal test runs.

CONCLUSIONS:

1. The AN/TRC-80 Communications Pack sustained no damage as a result of the vibration tests.

2. During vibration along the vertical axis the accelerometers on the Klystron tube transmission line indicated maximum accelerations.

3. During vibration along the lateral axis the accelerometers on the Klystron tube transmission line and on the engine-generator unit indicated maximum accelerations.

4. During vibration along the longitudinal axis the accelerometers on the Klystron tube transmission line, engine-generator unit and on the air conditioner condensor indicated maximum accelerations.

3 Incls
Appendix I
Appendix II
Appendix III

SUBMITTED:

G. R. Thomson

G. R. THOMSON
Mechanical Test Section

REVIEWED:

J. W. Apgar

J. W. APGAR
Chief,
Mechanical Test Section

APPROVED:

J. M. McKinley

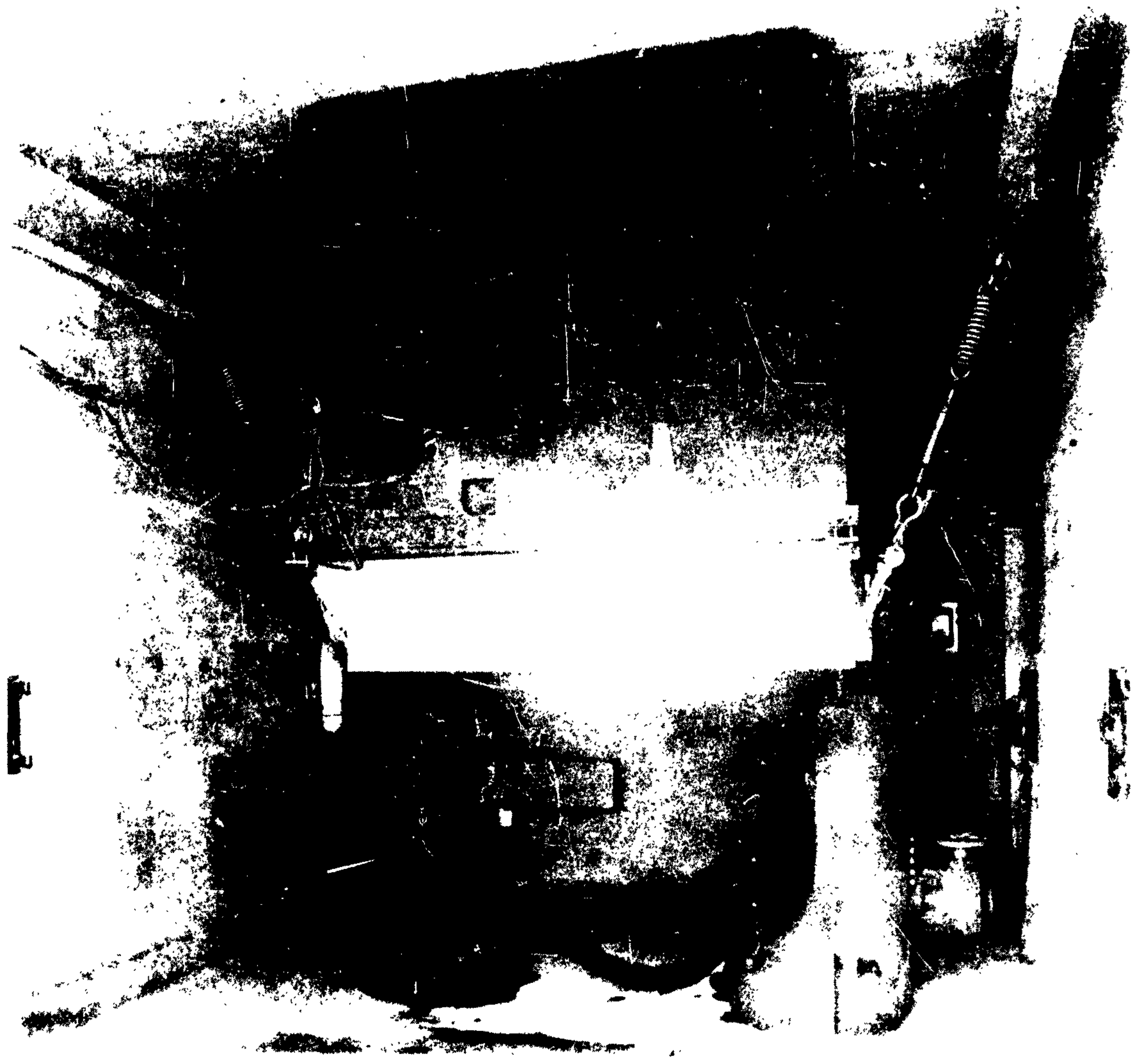
J. M. McKINLEY
Chief,
Physical Test Laboratory

Block No.	Unit	Vibration Direction	Accel. No.	Accel. Block Location
1	Generator	Vert Longit Later.	25 26 27	On angle at base of generator isolator below regulators.
2A	Generator	Vert Longit Later.	28 29 30	One block on each of the two generators mounting brackets (generator to base fixture). Inner hut side of generator.
2B	Generator	Vert Longit Later.	31 -- 32	
3	Generator	Vert Longit Later.	33 34 --	On generator mounting bracket (generator to base fixture). Outer hut side of generator
4	UHF Power amplifier	Vert Longit Later.	10 11 12	On 1 5/8 inch rigid Klystron transmission line below power output directional coupler.
5	UHF Power amplifier	Vert Longit Later.	7 7 7	On mounting base of Klystron tube below isolator. One accel. rotated as required.
6	UHF Power amplifier	Vert Longit Later.	4 5 6	On top of Klystron tube collector magnet.
7	UHF Power amplifier	Vert Longit Later.	1 2 3	On structure of rack below metering and power control unit.
8	Air Conditioner	Vert Longit Later.	35 -- --	On condensor support frame at base of the Isolator furthest from hut corner.
9	Air Conditioner Condensor	Vert Longit Later.	36 37 38	Top corner of condensor directly above instrumented isolator.
10	Air Conditioner Evaporator	Vert Longit Later.	16 16 16	On rigid structure just above the upper isolator for the lower unit. The isolator is furthest from the side wall. One accel. rotated as required.

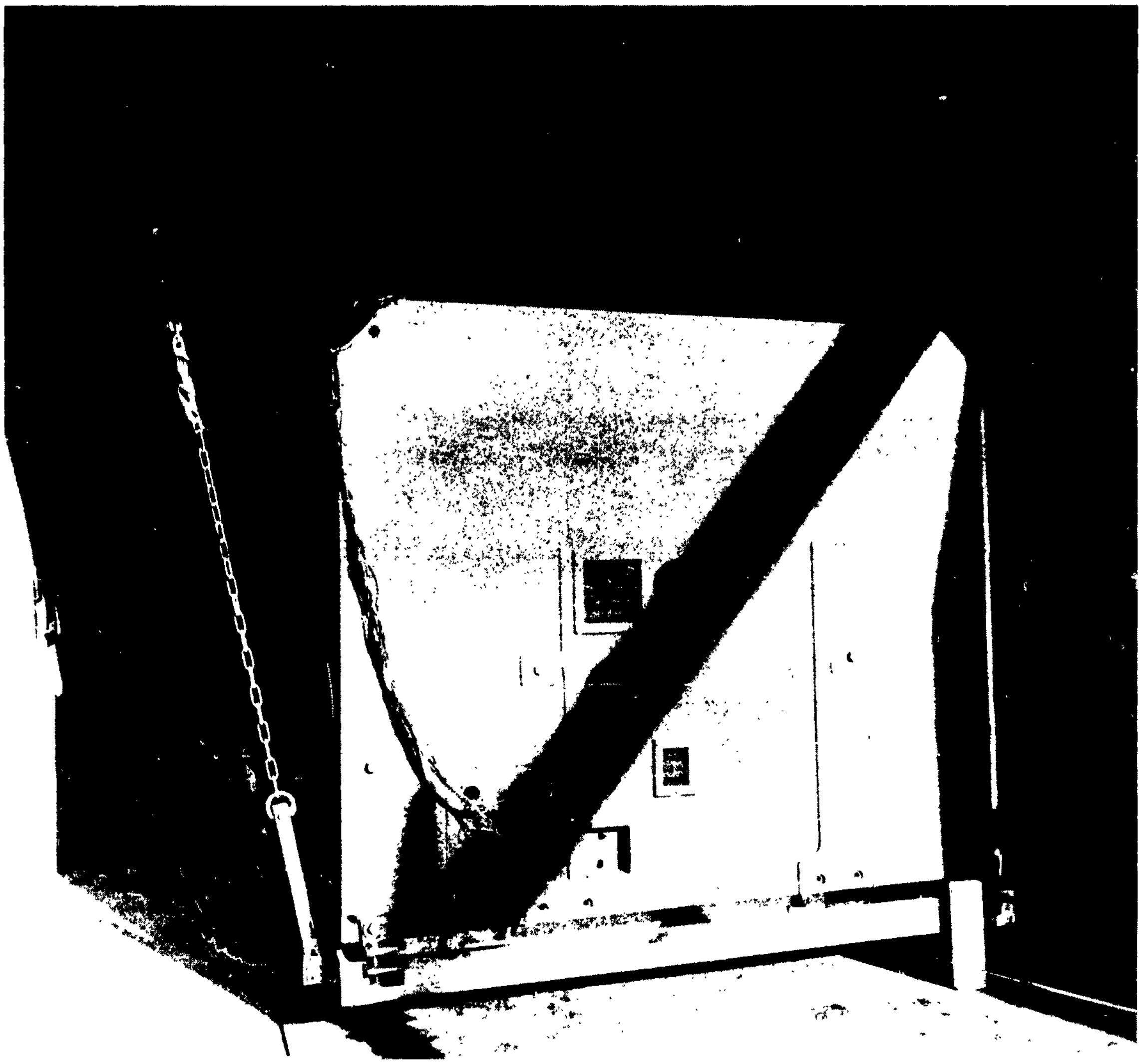
Appendix I

Block No.	Unit	Vibration Direction	Accel. No.	Accel. Block Location
11	Air Conditioner Evaporator	Vert Longit Later.	19 20 21	On the upper corner (furthest from the side wall) of the lower unit.
12	Freq. Stds. & Synthesizers & Controls	Vert Longit Later	22 22 22	Approximately 30 inches above the floor on the structure between the control panels and Freq. Stds. & Synthesizer Equipment on rack No. 3. One accel. rotated as required.
13	Receiver	Vert Longit Later.	23 23 23	Approximately 30 inches above the floor on structure between the receiver racks numbers 4 and 5. One accel. rotated as required.
14	Pack	Vert Longit Later.	24 24 24	In corner of Pack near generator. One accel. rotated as required.
15	Exciter	Vert Longit Later.	13 13 13	On center of Rack No. 1 structure between the deviation and level monitor and the UHF Converter amplifier. One accel. rotated as required.
16	Teleprint Table	Vert Longit Later.	17 17 17	On center of under side of Teleprint Table. One accel. rotated as required.
17	Receiver	Vert Longit Later.	18 18 18	On chassis. One accel. rotated as required.
18		Vert Longit Later	-- -- 39&40	Accel. used only during one lateral vibration test run - No. 39 measured along vertical axis and No. 40 measured along lateral axis.

Appendix I



S18-001-3834-1430-55-7T/ORD-60: Vertical Vibration Test Setup - End View.



S18-001-3864-1430-55-9T/ORD-60: Lateral Vibration Test Setup - Rear View.

S18-001-37-1430-55-1T/ORD-61: Horizontal Longitudinal Vibration Test Setup. Front End View.

Maximum Significant Accelerations

Accelerometer			Test Freq. cps	Max. Accel. g	(1) Exciter input g	(2) Magn. Ratio	Remarks
No.	Sensitive Axis	Unit					
10	Vertical	UHF Power amplifier	30	0.81	0.75	1.08	Klystron Tube Trans. Line in original config.
11	Longit.		30	0.55	0.75	0.73	
10	Vertical	UHF Power Amplifier	37	0.02	0.75	---	Klystron Tube Trans. Line in Revised Config.
11	Longit		37	0.015	0.75	---	

(1) Exciter Input - Reading of accelerometer mounted in C-210 Exciter.

(2) Magnification Ratio - Maximum acceleration (g) $\div$ Exciter Input (g).

Vertical Vibration Test Run Outline

No. of Runs	Exciter Input	Frequency Sweep Range
1	0.25 g	15 to 500 cps
1	0.50 g	15 to 500 cps
3	0.75 g	15 to 500 cps

TABLE I: Vertical Vibration Test Results

Appendix III

Maximum Significant Accelerations

Accelerometer No.	Sensitive Axis	Unit	Test Freq. cps	Max. Accel. g	(1) Exciter Input g	(2) Magn. Ratio	Remarks
10	Vertical	UHF Power amplifier	25	0.45	0.75	0.60	Klystron Tube Trans. Line in original config.
11	Longit.		25	0.36	0.75	0.48	
29	Longit.	Generator	10	0.67	1.0	0.67	
30	Later.		10	0.99	1.0	0.99	
31	Vertical		10	0.53	1.0	0.53	
32	Later.		10	0.73	1.0	0.73	

(1) Exciter Input - Reading of accelerometer mounted in C-210 Exciter. Accelerometer No. LA-1, shown in Figure 4, Appendix II, indicated within 10% of the Exciter Input.

(2) Magnification Ratio - Maximum Acceleration (g) ÷ Exciter Input (g).

Lateral Vibration Test Run Outline

No. of Runs	Exciter Input	Frequency Sweep Range
1	0.25 g	10 - 500 cps
1	0.50 g	10 - 150 cps
2	0.50 g	10 - 500 cps
3	0.75 g	10 - 50 cps
3	0.75 g	10 - 500 cps
2	1.0 g	10 - 100 cps
4	1.0 g	10 - 500 cps

TABLE II: Lateral Vibration Test Results

Appendix III

Maximum Significant Accelerations

Accelerometer No.	Sensitive Axis	Unit	Test Freq. cps	Max. Accel. g	(1) Exciter Input g	(2) Magn. Ratio	(3) Accel. No. LO-1 g
10	Vertical	UHF Power amplifier	20	0.38	0.75	0.51	0.64
11	Longit.		20	0.41	0.75	0.55	0.64
29	Longit.	Generator	10	0.37	0.75	0.49	0.20
30	Lateral		10	0.40	0.75	0.53	0.20
36	Vertical	Air	8	0.53	0.75	0.71	0.20
37	Longit.	Conditioner	8	1.12	0.75	1.50	0.20
38	Lateral	Condensor	8	0.90	0.75	1.20	0.20

(1) Exciter Input - Reading of Accelerometer mounted in C-210 Exciter.

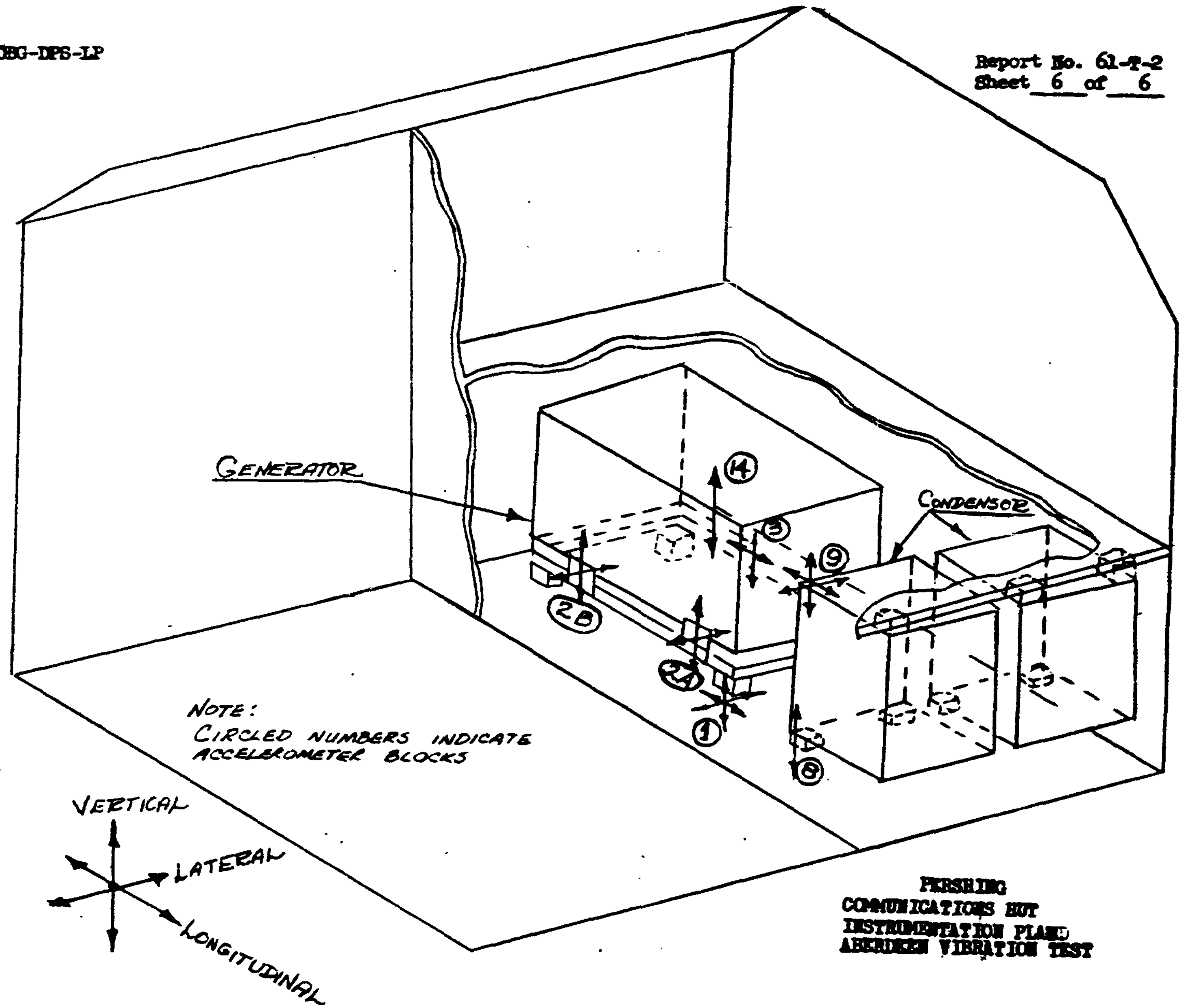
(2) Magnification Ratio - Maximum Acceleration (g) ÷ Exciter Input (g).

(3) Accelerometer No. LO-1 mounted on Pack as shown in Figure 6, Appendix II.

Longit. Vibration Test Run Outline

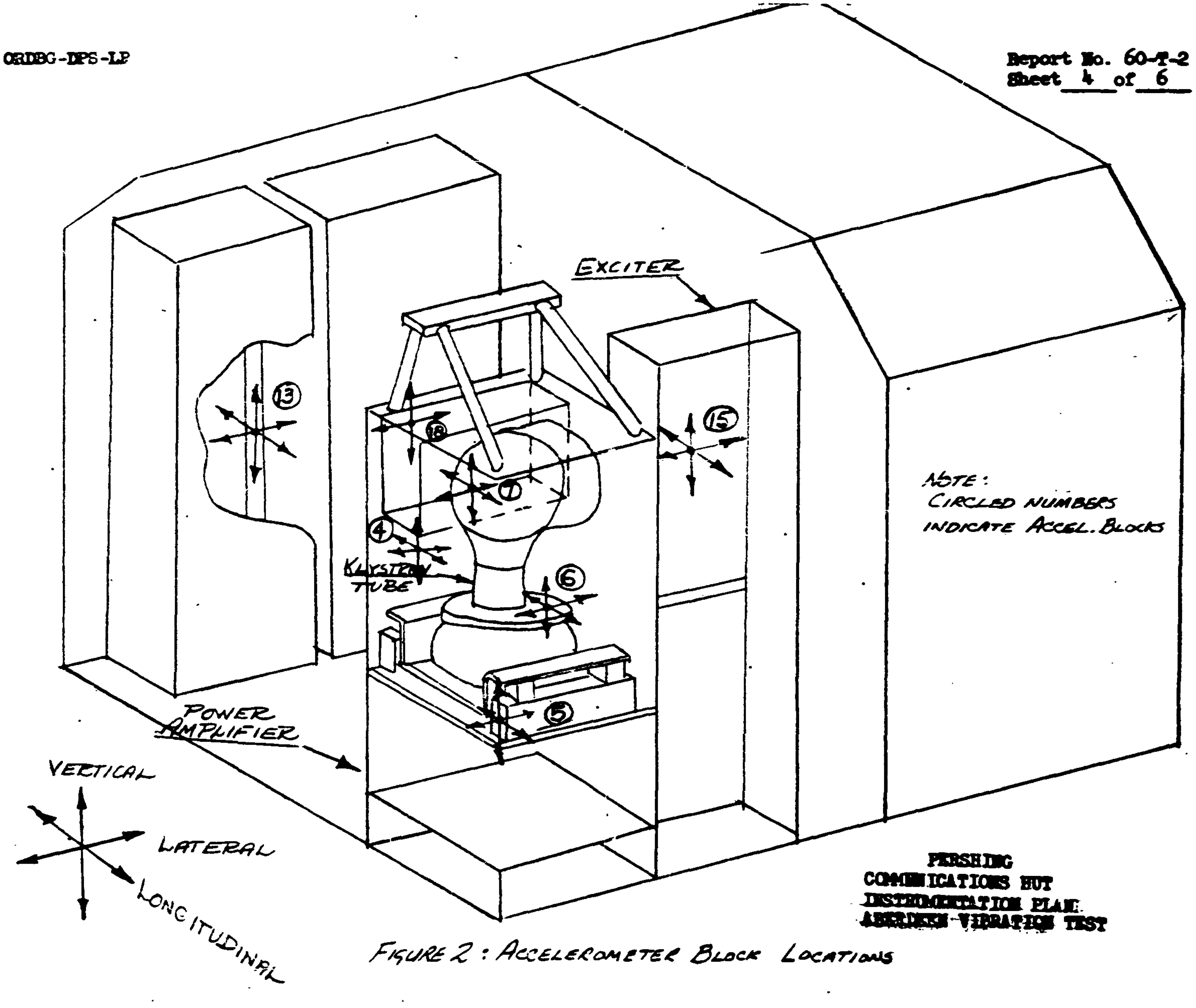
No. of Runs	Exciter Input	Frequency Sweep Range
2	0.0095" D.A.	5 - 8 cps
1	0.25 g	8 - 500 cps
1	0.50 g	8 - 50 cps
2	0.50 g	8 - 500 cps
1	0.75 g	8 - 50 cps
3	0.75 g	8 - 500 cps

TABLE III: Longitudinal Vibration Test Results



PERSHING
COMMUNICATIONS HUT
INSTRUMENTATION PLAN
ABERDEEN VIBRATION TEST

FIGURE 4
APPENDIX I



PERSHING
COMMUNICATIONS HUT
INSTRUMENTATION PLAN
ABERDEEN VIBRATION TEST

FIGURE 2: ACCELEROMETER BLOCK LOCATIONS

FIGURE 2
APPENDIX I

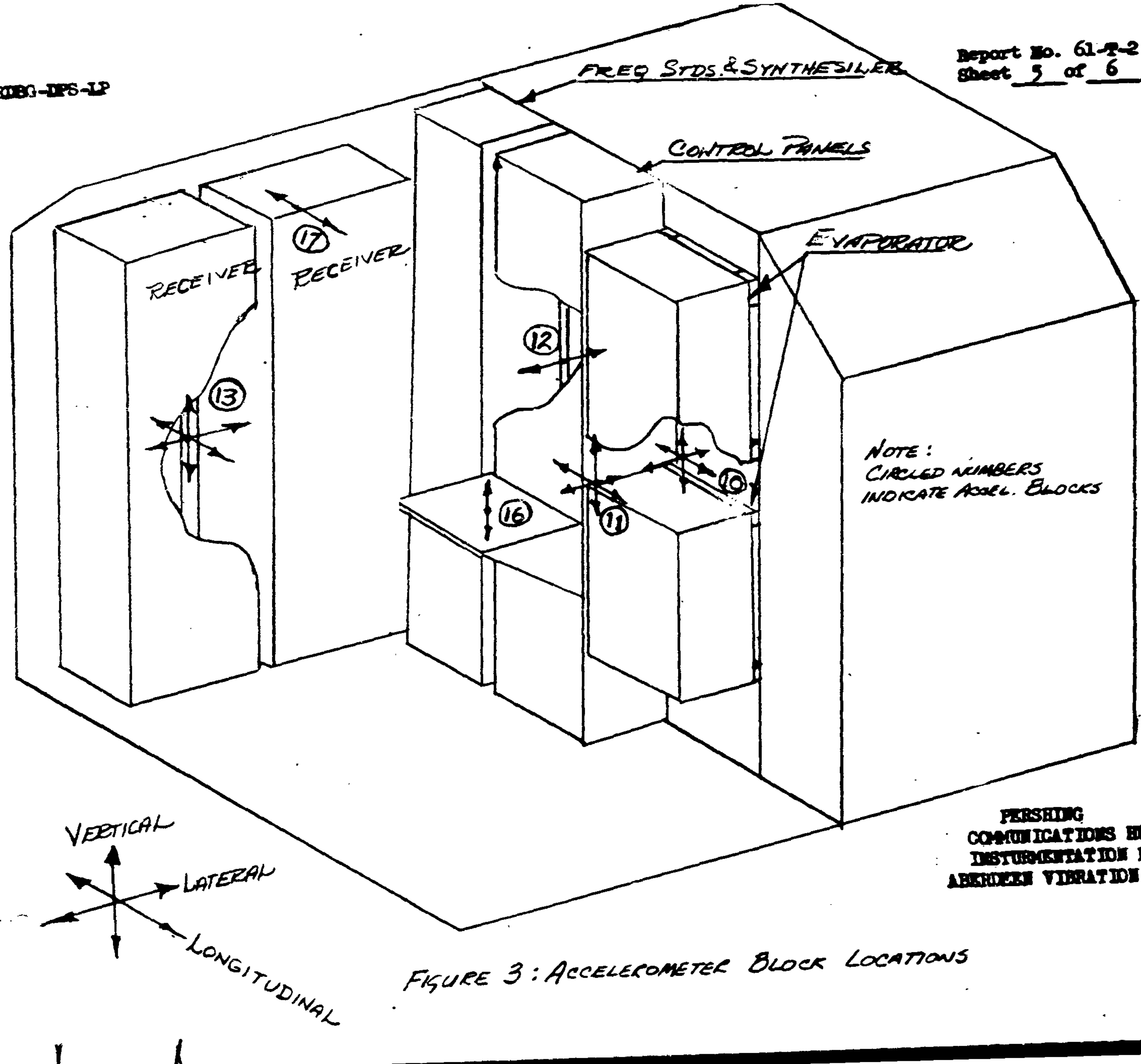
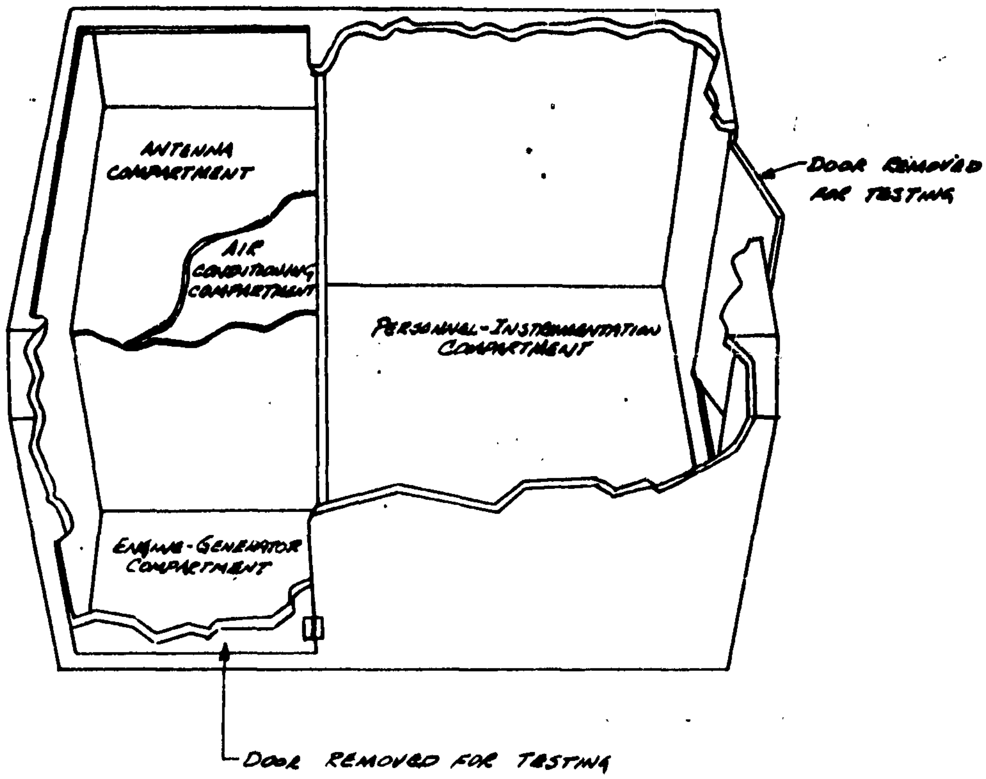


FIGURE 3: ACCELEROMETER BLOCK LOCATIONS

PERSHING
COMMUNICATIONS HUT
INSTRUMENTATION PLAN
ABERDEEN VIBRATION TEST

FIGURE 3
APPENDIX I



NOTES:

1. AIR CONDITIONING COMPARTMENT PANEL, NOT SHOWN, REMOVED FOR TESTING.
2. PACK COMPONENTS NOT SHOWN.

FIGURE 1 : MAIN COMPARTMENTS - AN/TRC-80 COMMUN. PACK

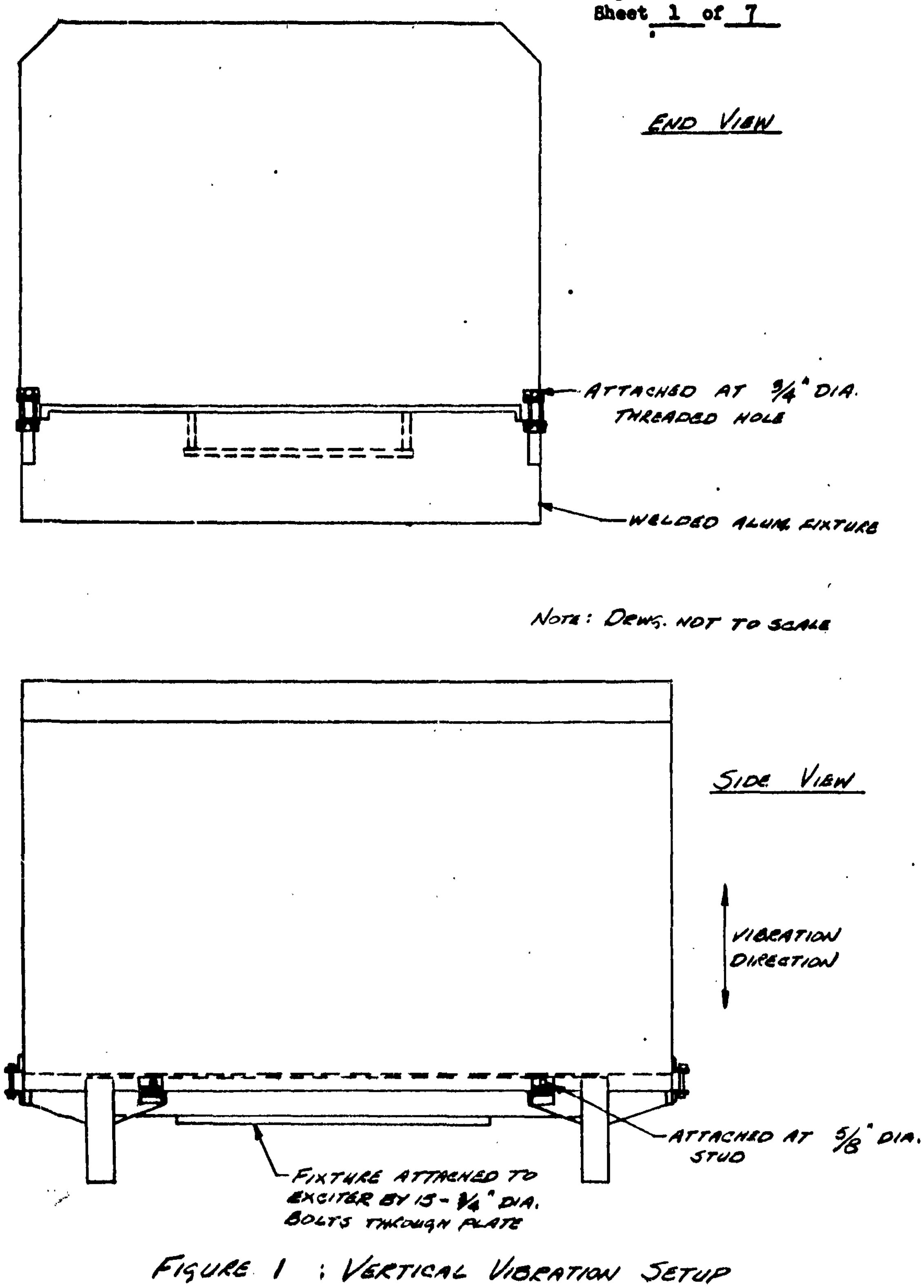


FIGURE 1 : VERTICAL VIBRATION SETUP

APPENDIX II B-149

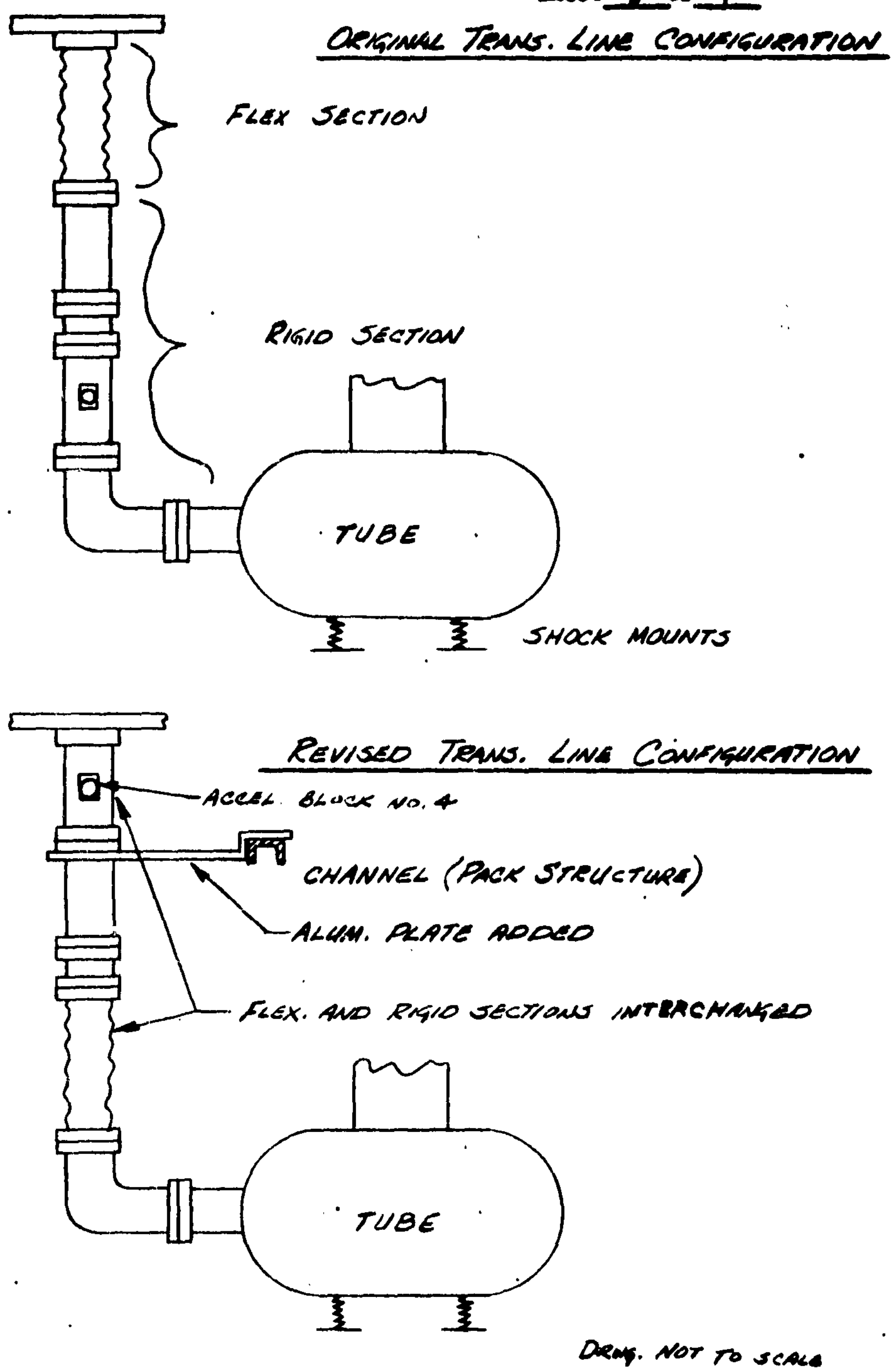


FIGURE 3: KLYSTRON TUBE TRANSMISSION LINE CONFIGURATIONS

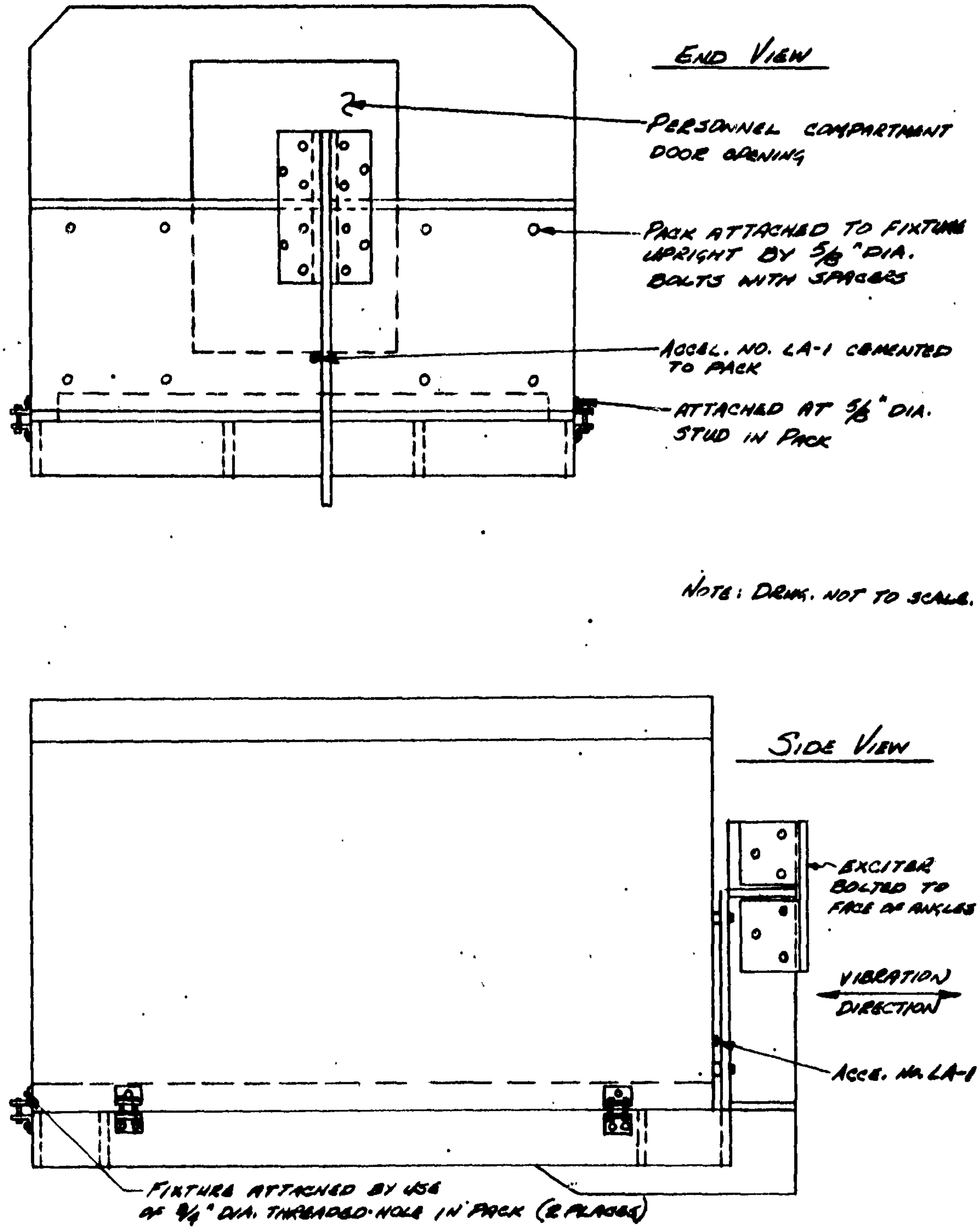
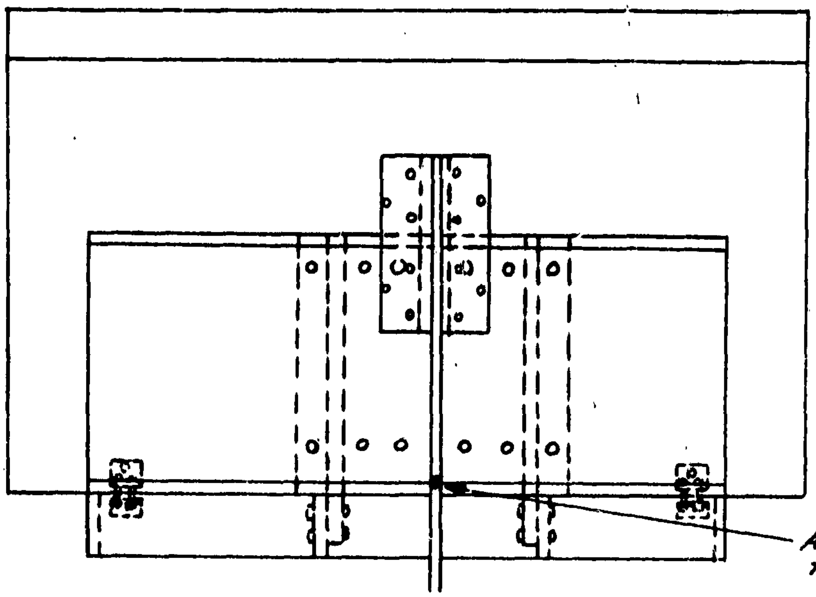


FIGURE 4: LATERAL VIBRATION SETUP
APPENDIX II



NOTE: DRWG. NOT TO SCALE

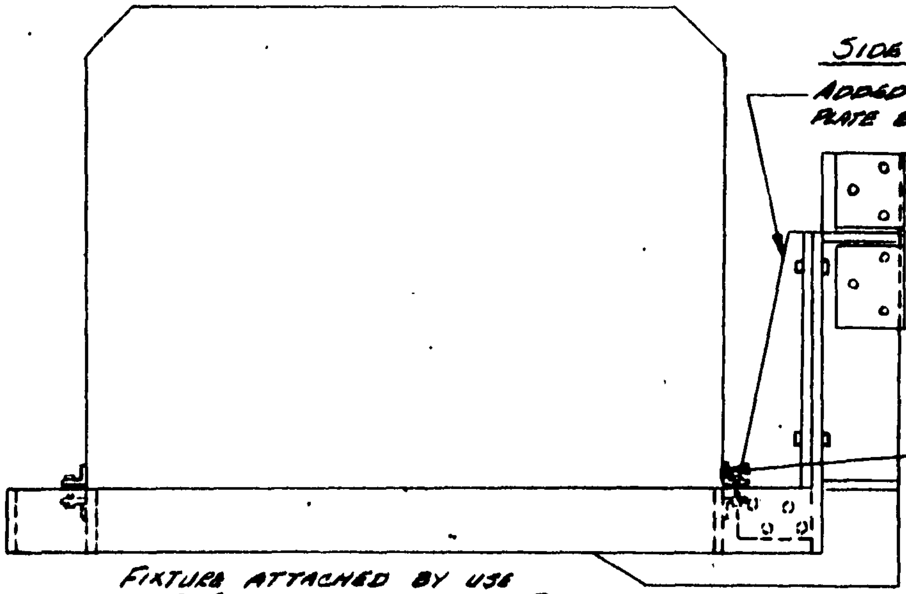


FIGURE 6: LONGITUDINAL VIBRATION SETUP

APPENDIX C

Distribution

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Commanding Officer U. S. Army Ordnance Test Activity Yuma Test Station Yuma, Arizona Attn: ORDBG-TA-AS	1
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Commander Armed Services Technical Inf Agency Arlington Hall Station Arlington 12, Va.	10
CONARC Liaison Office Aberdeen Proving Ground, Md.	3
Navy Liaison Office Aberdeen Proving Ground, Md.	1
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AD_____ Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
ENVIRONMENTAL TEST OF PERSHING COMMUNICATIONS
PACK NO. 1 - R. L. Wiles

Report No. DPS-244
OMS 5210.12.127X2.03.39
Unclassified Report

The communications pack was subjected to a wide range of environmental conditions including climatic phases of rain, wind, high and low temperatures, humidity and icing; table vibration consisting of a low-input resonance search in the three major axes; and a road-shock and vibration test at various road speeds over the 6-inch washboard, level paved and ramp courses. It was recommended that action be taken to correct the shortcomings encountered and that an improved version be subjected to further testing.

AD_____ Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
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D&PS, Aberdeen Proving Ground, Maryland
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OMS 5210.12.127X2.03.39
Unclassified Report

The communications pack was subjected to a wide range of environmental conditions including climatic phases of rain, wind, high and low temperatures, humidity and icing; table vibration consisting of a low-input resonance search in the three major axes; and a road-shock and vibration test at various road speeds over the 6-inch washboard, level paved and ramp courses. It was recommended that action be taken to correct the shortcomings encountered and that an improved version be subjected to further testing.

AD_____ Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
ENVIRONMENTAL TEST OF PERSHING COMMUNICATIONS
PACK NO. 1 - R. L. Wiles

Report No. DPS-244
OMS 5210.12.127X2.03.39
Unclassified Report

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